The Mechelecin

VOL. 15 NO. 3

SCHOOL OF ENGINEERING
THE GEORGE WASHINGTON UNIVERSITY

DECEMBER 1955

Robert T. Blake, Class of '49
speaks from experience when he says,

"At U.S. Steel, the opportunities are unlimited."

Bob Blake had his first experience in steel mills working there during summer vacations from college. After receiving his B.S. degree in Electrical Engineering, he became an operating trainee in U.S. Steel's Irvin Works. During his training program, his background and versatility were used by the Training Division to develop a training program for Electrical Maintenance employees. By the end of 1951, Mr. Blake had become a Foreman with experience in both Cold Reduction Maintenance and the Galvanizing Department.

Effort is made to have young engineers obtain varied experience before devoting themselves to one field. Mr. Blake feels that, "An engineering graduate has practically no ceiling provided he has the right attitude and is willing."

Promoted again in 1954, Mr. Blake is now Foreman—Electric Shop in Central Maintenance. Supervising a crew of 40 men, he is responsible for electrical construction work, maintenance and crane wiring. Mr. Blake feels he is in "an interesting and challenging field of work." He has found that "U.S. Steel is a highly desirable employer in this most basic of all industries."

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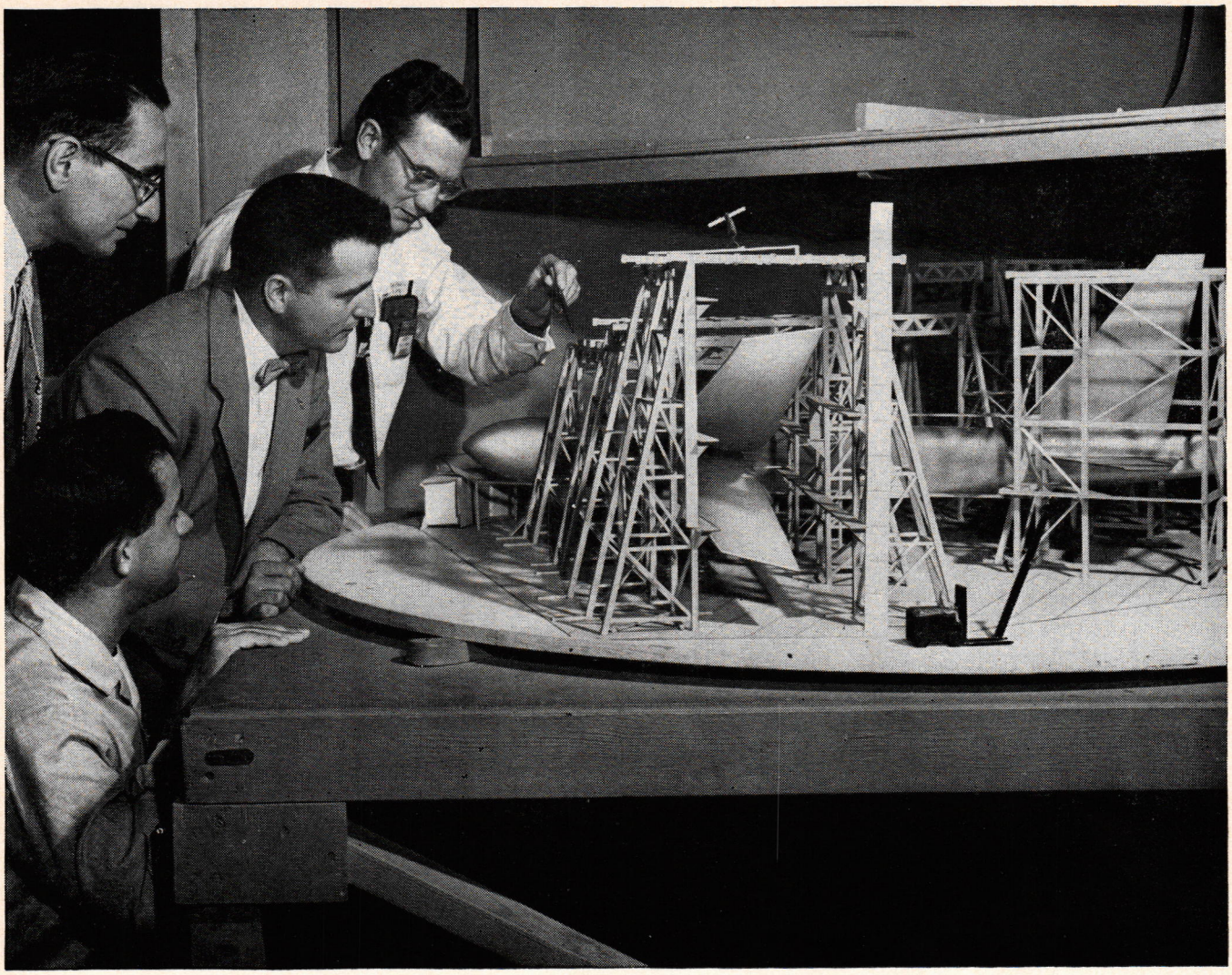

Boeing engineers work with stimulating associates

Many engineering skills are represented in this picture. Mechanical, civil, electrical and aeronautical engineers—in almost equal proportion—work closely together in planning and conducting the structural test of airplanes such as the B-52. This stimulating contact among experts in every field is typical of Boeing projects. It makes a good engineer even better, and helps his professional growth.

In no other industry does the engineer have the opportunity to evaluate so completely—through destruction testing—the structural integrity of such a large and complex product. It is a "classical" challenge for mechanical and civil engineers. It tests the instrumentation ingenuity of electrical engineers and gives aeronautical engineers an opportunity to proof check designs by translating theoretical air loads into practical test loads.

Many immediate problems and "years ahead" projects involving these same skills and their infinite variations are under way at Boeing. The application of rocket, ram-jet and nuclear power to current and future aircraft and missiles is typical of projects in active study. Applied research in developing materials and components to withstand the tremendous heat and stress of flight at supersonic speeds offers even further opportunities to express engineering talent.

More than twice as many engineers are with Boeing now than at the peak of World War II—evidence of the company's solid growth. This outstanding group of engineers has been responsible for such aviation landmarks as the 707 Stratoliner jet transport and its KC-135 military tanker version, the Bomarc IM-99 guided missile, the global B-52 jet bomber and the B-47 jet bomber, present backbone of Strategic Air Command.

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▪ ▪ ▪

Below: Missile Systems scientists and engineers discuss future scientific exploration on an advanced systems concept with Vice President and General Manager Elwood R. Quesada. From left to right: Dr. Eric Durand, nuclear physicist, systems research laboratory; Ralph H. Miner (standing), staff division engineer; Dr. Montgomery H. Johnson, director, nuclear research laboratory; Elwood R. Quesada; Dr. Louis N. Ridenour (standing), director, program development; Willis M. Hawkins (standing), chief engineer; Dr. Joseph V. Charyk (standing), director, physics and chemistry research laboratory; Dr. Ernst H. Krause, director, research laboratories.

▪ ▪ ▪

Those receiving Ph.D., M.S. and B.S. degrees are invited to write for information regarding their role in advanced research and development at Lockheed Missile Systems Division. Your Placement Officer can also arrange an interview with members of the technical staff who will be on campus this coming spring.

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research and engineering staff

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SCHOOL OF ENGINEERING, THE GEORGE WASHINGTON UNIVERSITY

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ON OUR COVER

The modern M-48 tank is a far cry from its ancestor shown in the upper right corner. Da Vinci probably never envisioned such an evolution from his original model.

Cover by SHEILA LANE

FRONTISPIECE

Unbelievable though it may seem, this beam of light is an effort to minimize noise near heavily populated areas. It serves as an aerial traffic light to planes departing from LaGuardia Airport. The 300-million beam candlepower searchlight routes planes over a more sparsely settled area.

Photo courtesy of WESTINGHOUSE

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Confusion —

And Conflict

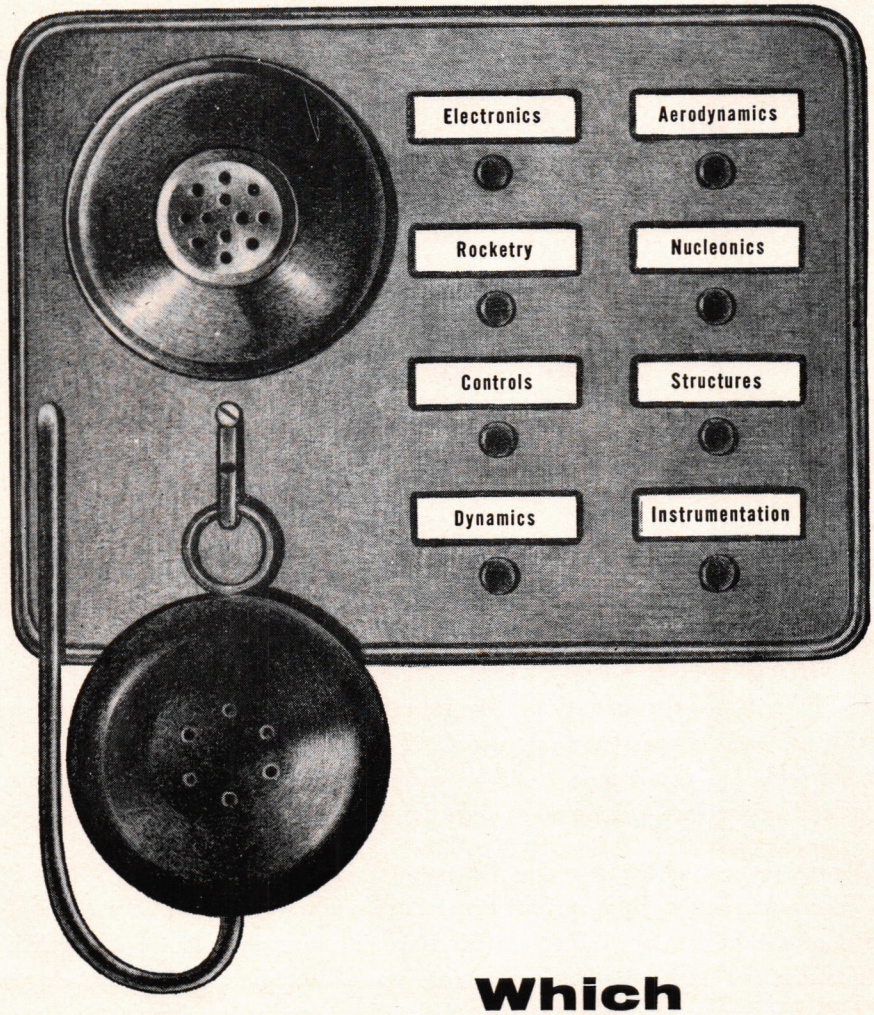
Last year at this time, MECHELECIV was in its fourteenth volume, faculty cars covered the lot between 22nd, and 23rd, G and H Streets, and there were some changes in the Engineers' Council constitution. As this third issue of MECHELECIV'S fifteenth volume goes to press, incipient Tompkins Hall occupies the old faculty lot and the structure of the Engineers' Council has been changed and made a reality with the elections of last April. To base predictions for this year upon what has happened in the past would be foolhardy; like the field of engineering, the School of Engineering progresses at an accelerated pace each year.

To the faculty of the school of engineering and to the staff of MECHELECIV each year represents a definite challenge. The faculty must try to keep the students abreast of the advancing field of engineering, yet must stick to the old principles and .foundations that provide an engineer with the basic tools of his trade. MECHELECIV must endeavor to give the students and alumni a better magazine each year, yet must not make any change so radical as not to retain identity with its "old self." In one respect MECHELECIV is fortunate; a student opinion poll is being planned to determine just what is wanted in the student magazine; the faculty rarely gets such a chance to review itself until its product has graduated and has been working for a few years.

What then should MECHELECIV do? Should its editorials and articles harp on the need for extra-curricular activities for engineers, which has been stressed so heavily in the past? Should it stress, as does the faculty, the extreme need for a knowledge of writing, or just plain English among engineers?

To those in the School of Engineering who are engaged in extra-curricular activities, it seems most natural to do so as a part of their everyday life as professional men. In the engineering field itself there seems to be constant confusion over whether to "humanize" the engineer or make him technically proficient as possible.

To MECHELECIV, there is a conflict on just what to publish for and to a group who seldom lets its feelings be known. With advance planning and discussion, and with ideas and criticisms obtained at the recent Engineering College Magazines Associated Convention, the staff of MECHELECIV presents in this issue another glimpse of its "new self."



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MARTIN
BALTIMORE

FACULTY PAGE

WERE YOU PREPARED ?

By Dean Martin Mason

The probability is good that when you entered GW, you were not prepared to meet and satisfy the demands made upon you by your college. Your preparation for life had not developed the background of knowledge and the self-discipline adequate to the demands put upon you by your college. Can I support this surprising statement - I think so.

Remember, each of you was recommended by your high school as being prepared to complete college successfully, and your high school grade record placed you in the upper 3/5 of your high school class (a few of you were lower but qualified because of special circumstances). What then is the evidence that the majority of students entering George Washington, particularly in engineering study, are inadequately prepared? Let's look at the record.

This Fall 784 of you took a placement test in English and 242, or 32%, had to be placed in a remedial course. Each year some of you who enter science or engineering study take a placement test in Physics; on the average 4 out of 5 fail the test and are required to enter a first course in Physics along with those who did not "take" Physics in high school. This despite the fact that only those who have had a Physics course including laboratory work in high school are permitted to enter the placement test. In Engineering Orientation (a first term course for entering engineering students) one assignment produced papers from 174 students; of the 174 papers, 144 contained one or more spelling errors. A study habits test given a group of 40 students showed that 28 of the 40 students had no idea of the elements of effective study. Reading tests given the same group showed gross deficiencies in vocabulary, speed of comprehension, and level of comprehension in about 80% of the group tested.

The list of deficiencies can be expanded to include additional academic subjects, and, most serious of all, to include a distressing lack of discipline. I mean here the self-discipline that is the core and heart in each of us of our standards of responsibility, of achievement, and of behavior. I mean the type of discipline that is essential to each and all of us when confronted by difficult or unpleasant situations, those things many refer to as "the stern facts of life." As Dean, I see far too many of you in my office, in various states of bewilderment or despair, when faced by minor crises in your personal or school life that you should take in stride. In these situations some of you exhibit the intestinal fortitude of a rabbit. You won't (or can't) make decisions; you run when you should stand and fight; a few of you cheat when integrity would solve the problem; you seek the "easy way" when you should face the rigor of the "right way."

What can I say to those of you in the unfortunate position of being inadequately prepared? Just this: you are certainly not in a hopeless position; but you must seek and find for yourself those qualities, that background, and those strengths that those responsible for your growth and preparation have not insisted you find and develop. We and others are anxious to help you; but you must make the decision that you want help. If you decide you want strength, and you are willing to do the things required, you can achieve the development you need. Don't waste your substance in recrimination and railing, rather devote yourself to the task of remedy. Of course, being human you will undoubtedly praise, or blame, your teachers, yourself, and your parents as you triumph or fail in the life contests you will surely meet.

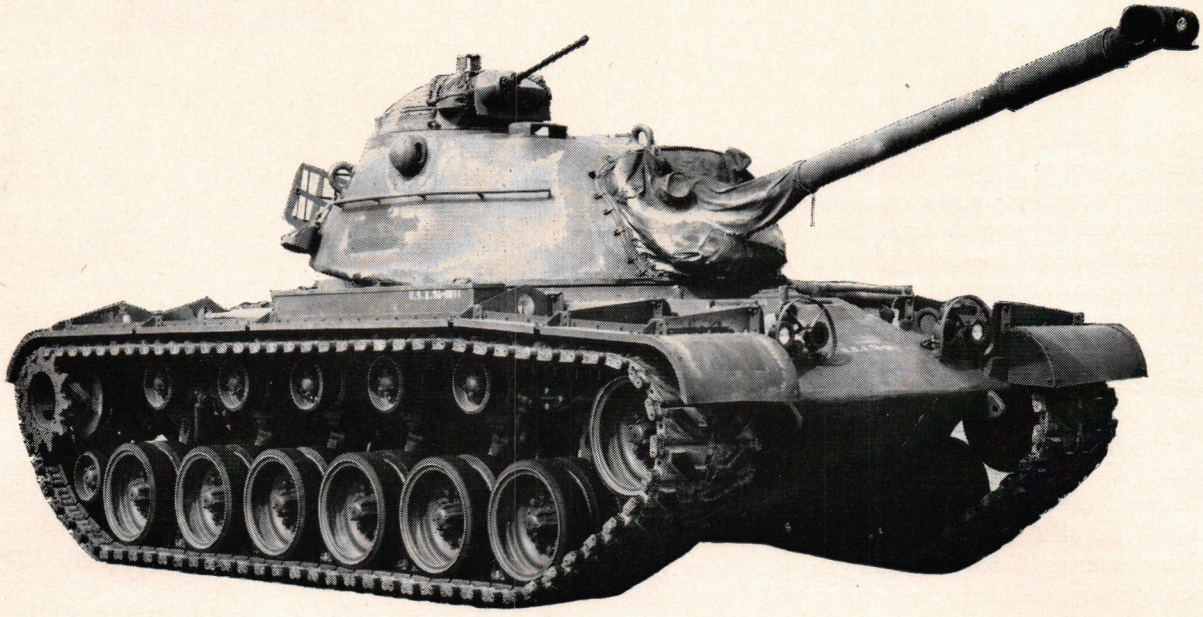
Perhaps you are offended, perhaps you are angry at me for what I have written, and perhaps you have reasons for these feelings. My only response and defense lies in

- - - - By their works shall ye know them.

Systematic Torture

By David Salto B.E.E., '58

DAVE (Fritz) SALTO at this writing is still a citizen of Egypt. Dave has been in the United States since 1948, and will receive his citizenship papers within a few months. His hobbies include mechanical devices and sports cars.



Our Cover Tank, The M-48

The American Army depends, more than any other in the world, on superiority in weapons and mechanized equipment — the essential element of warfare known as ordnance. To maintain this superiority it is necessary to have not only industrial volume, supplied by private industry under government contract, but testing facilities. These testing facilities serve two primary purposes: they determine supply research data for development, and, once the development is complete, they determine whether the end product is good enough for the Army. The best-known proving ground for guided missiles is at White Sands in New Mexico, but if the Army wants to test anything from a sidearm to a truck, a tank, or the atomic cannon, the tests are going to be run at Aberdeen Proving Ground, on Chesapeake Bay.

On an aerial map of Maryland, Aberdeen Proving Ground appears as a rectangular area just north of Baltimore, with very explicit map markings forbidding flying over the area. The reservation itself is flat Maryland bottom land, where deer, who see no difference between a game preserve and a Federal proving ground, sometimes stand and watch the machines on the test tracks. These test tracks are just one part of Aberdeen. The land edges on the river, so that swamps dot the area, making ideal mud courses. Other test courses, which are kept reasonably dry, include one to simulate rough terrain, which makes up for its dryness by being unreasonably uneven. Another, the Churchville Test Course, includes a 60% grade, with a brook at the bottom to simplify matters further. One problem on the

Aberdeen Proving Ground

test courses is keeping the road bottom in a bad enough condition of repair. Rain, the high water level of the area, and the constant pounding of deep tread tires and tank treads tend to smooth out rough spots and turn the terrain into relatively harmless mud. Work is constantly being done on the tracks to keep them in a condition as bad as the weapons will meet under actual use.

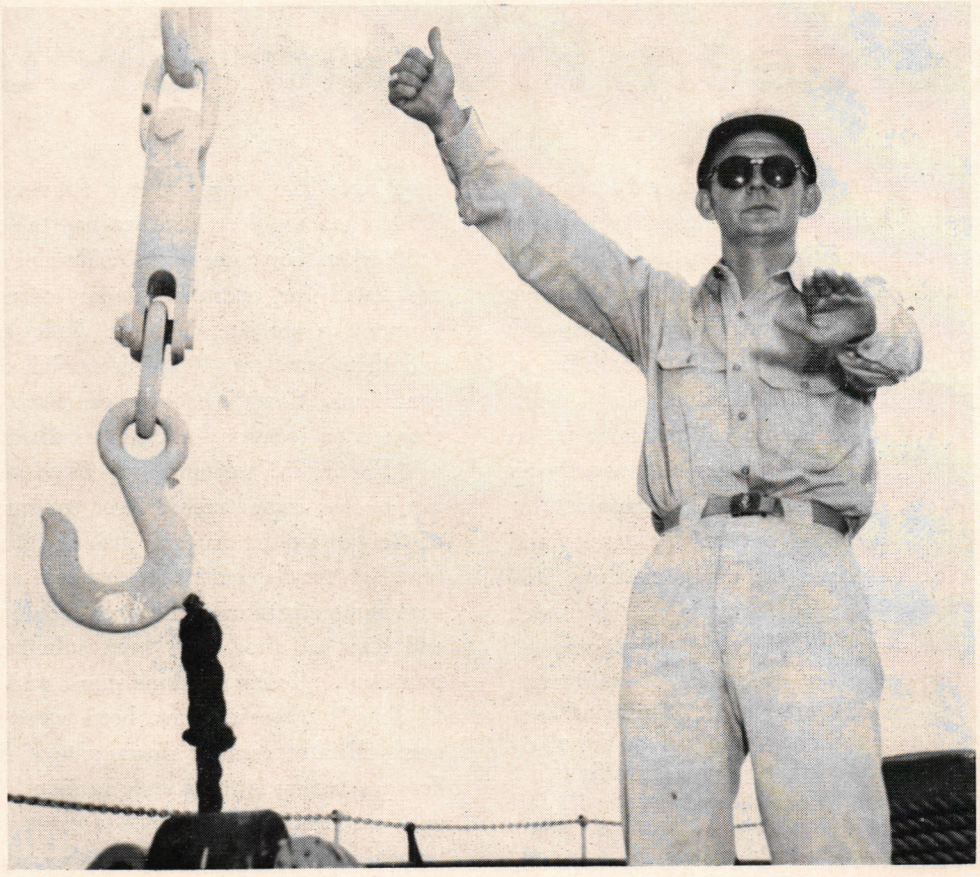
The Army's method of testing rolling stock is, on the surface, simple. The vehicle under test, usually an expensive, hand-made model sent by the manufacturer in perfect condition, is taken out on the tracks and wrecked. This wrecking is a technical, exacting, and coldly practical process. The Army is not interested in the theoretical merits of its ordnance. It is interested in knowing the weakest part of each piece of equipment, and the next weakest part after that. Unlike Oliver Wendell Holmes' "one-hoss shay," in which the parts were so wonderfully matched that nothing gave first, but all collapsed together, any piece of equipment will fail in one place more often than another. The job of the test driver is to cause mechanized failure by making this equipment suffer until something gives. The test driver's opinion of the equipment he handles is perhaps the most important part of an automotive test at the Proving Ground. The drivers inspect their machines before testing and fill out a routine report after the test, including a "remarks" section. The uncommon part of the tests is up to the driver. The machine tested must last long enough to give up a certain amount of information about itself before disintegrating, but it must be driven hard enough to eventually disintegrate. The damage to a test vehicle usually begins with minor parts and goes on until it becomes inoperative. The thin line between useless and informative destruction is for the test driver to discern.

If a tank, truck or any other vehicle puts up what the Army considers a manly fight on the test tracks, it is further tested on Aberdeen's huge M7. dynamometer. A dynamometer's purpose is to absorb either torque or tension while recording facts — such as fuel flow, temperature, and oil pressure — about the machine causing these forces. Small bench dynamometers are commonly used by the automotive industry, but the Army's is unique. It is almost 12 feet high, and there are 76 tons of it. It was built in 1946 at a cost of $750,000. It is designed to be towed, while putting up a constant resistance and measuring the effects of this resistance on whatever is towing it. This towing process is repeated in different terrain, and reports on the results are then issued by the automotive division of the Development & Proof Services.

Apart from vehicles, that carry the weapons, Aberdeen tests the Army's equipment that does the actual shooting. The ranges at the Proving Ground open at 8:30, when the deer have learned to leave, and close at 4:30, when they come back. Sidearms and mounted guns are tested for operation under extreme conditions of temperature and surroundings. Rifles are frozen for days and then tested at -40° to determine operation in Artic conditions. Sometimes Aberdeen actually sends ordnance convoys on location to Arctic or desert locations.

Rapid fire weapons are tested to determine their rate of fire, and eventually fired continuously until a part of the gun melts. Aircraft machine guns and cannon are tested at the Ground's "Stratosphere room," where pressure and temperature conditions are duplicated. All kinds and sizes of guns have been submitted to Aberdeen's treatment. Recent machine guns, with a rate of fire of 14 rounds a second, have been tested here. One large gun, with a necessarily slower rate of fire, which has undergone testing is the atomic cannon. The first time the gun was tested, it developed a crack in its 280. barrel, but a later model passed, and the gun has successfully fired a thermonuclear shell in A. E. C. tests. Another weapon first tested at Aberdeen was the Army's "Skysweeper" antiaircraft gun, a weird, frightening weapon that tracks enemy planes by radar, correcting automatically for wind and target speed and range, so that the gun weaves back and forth, suddenly erupting into a burst of firing, scattering shell casings behind it. The gun was on paper in 1944, and testing went on at the Proving Ground until late in 1950. In 1951, President Truman saw the model for the first time.

Probably the most important department in Aberdeen Proving Ground is the Ballistics Department where Ordvac — Ordnance Discrete Variable Automatic Computer — one of the best in the nation, is housed. There information from the weapons tests and the high-speed 2½ million dollar wind tunnel next door acquires meaning. A really impressive department, though, is Aberdeen's "graveyard," where captured enemy ordnance and domestic weapons that proved impractical are stored. Here is the German World War II railway gun, the same bore as the atomic cannon. One outstanding domestic weapon is the 914 mm. mortar the Army built to pierce Germany's concrete Siegfried line. The gun was never needed, but test material for its 3,000 lbs. shell came in handy in building shells for the atomic cannon. The graveyard is dotted with canvas-covered ordnance that failed in some way. Each one of the pieces here is an attempt at improvement, and each one supplied some information in looking for perfection in its ordnance. That is what the Army is looking for, and even though it knows it cannot be achieved, it likes to keep on trying. Aberdeen is where it tries.



Safe Handling — in this case a hoist hook is tied down.

—U.S. Coast Guard Photo

SAFETY

TOM CRESWELL is well qualified to write on the subject of Safety Engineering; he holds the position of Safety Coordinator at the Treasury Department. Tom's academic achievement is attested to by his membership in Sigma Tau, of which he is President.

ENGINEERING'S NEWEST FIELD

Shortly after the turn of the century America witnessed the beginning of a humane endeavor called the "Industrial Safety Movement." Available literature of the industrial development of New England indicates that safety was an integral part of the worker's struggle for higher pay and the struggle for shorter working hours and improved working conditions. As these conditions were progressively improved attention was turned to the suffering and waste that resulted from accidents.

The first reaction of workers' organizations and the workers themselves to accidents was that the victims of such accidents should be recompensed, in at least reasonable degree, for the injury suffered. The passage of legislation requiring employers to provide safeguards against specific hazards furnished at least some legal basis for the thesis, now thoroughly established by law and custom, that the employer is responsible for all injuries suffered by persons while they are performing work for which he employs them. With this newly acquired legal responsibility many employers began to realize that accidents could cut deep into operating costs.

In an effort to curb this unnecessary additional cost of operation, employers began to establish make-shift safety programs aimed primarily at guarding machinery and equipment. Along with guards came personal protective equipment worn by employees performing certain hazardous duties or working in hazardous areas. And with these measures accidents began to decline somewhat markedly. With this downward trend in the number of industrial accidents there was realized better employee morale, lower costs of operations, and increased productivity.

As management became more and more convinced of the value of accident prevention, safety programs were expanded and improved. More full time safety engineers were employed to establish or implement safety programs in many large industrial companies. These men were combination technical men, super salesmen, and policemen. They were managers with the responsibility for broad programming and liaison with top management. Most of the safety engineers worked in a staff capacity in that they advised top officials regarding organization safety policy and needs, and they worked in a line capacity in that they developed and put into effect a comprehensive safety program.

As the safety movement has increased in momentum, concepts have been broadened to include many factors other than machine guards and personal protective equipment. Safety engineers have come to realize that guards and protective equipment alone are not sufficient to totally eliminate accidents. There are many things such as the employee's home environment, his temperament, his physical capabilities, and his personality which must be considered in accident prevention.

Safety actually encroaches upon many fields—among these are industrial psychology and employee relations. For this reason the safety engineer must have a working knowledge of practically all of the components of the organization. He must have knowledge of such things as production procedures, the processing, the office operations, and the storage and distributions methods in order that he may help to develop the safest method of performing these functions.

Today's comprehensive safety program includes a multitude of sub-programs, all of which contribute to the ultimate goal — prevention of accidents. Into these sub-programs fall machine guarding and personal protective equipment, but there are others of equal importance. An inspection program, for example, is essential for the ultimate success of the safety program. In some companies the safety engineer makes the periodic inspections of the work areas and equipment, while in other companies this function has been delegated to committees. The latter probably stimulates greater employee participation, but it lacks the technical experience and the sharp eye of the safety engineer.

Another essential sub-program is a training program. This is usually divided into two phases: 1) supervisory safety training, and 2) employee safety training. The training for supervisors is usually conducted by the safety engineer and is aimed at showing the supervisor that the final responsibility for safety rests with the supervisory staff. Employee training is usually conducted by the supervisor and is given in a variety of forms such as brief five-minute talks or classroom sessions.

Much of the training may be developed from post accident experience. This requires a sub-program for keeping adequate accident records. This is accomplished by use of relatively simple report forms to be prepared by every injured employee and his supervisor. The forms should be so devised that answers to the following questions are ascertained: 1) the name of the injury, e.g., sprain, fracture, etc.; 2) What part of the body was injured; 3) How did the object, substance, or motion produce injury; 4) What inflicted the injury; and 5) *Why* did the event occur? The answer to the last question is the *cause* of the injury and provides the basis for accident prevention. Causes may be divided into two categories — personal causes, or unsafe acts; and physical causes, or unsafe conditions.

Once this information is compiled for a number of injuries, careful analysis will indicate trends or will point up areas that need special attention. Statistical data,

(Please turn to Page 18)

PUSH-BUTTON DRAINAGE

By Louis Dougherty, B.E.E., '56

LOUIS DOUGHERTY is by vocation an engineer; he is presently connected with the Department of Agriculture. This paper, originally presented in a proseminar class, was recommended by the E. E. Department as an example of research well done.

While coarse-grained soils such as sands and gravels can be drained easily by ordinary methods, fine-grained soils of the silty and clayey types, because of their ability to retain water and their low permeability, cannot. In practice, various cases arise where special methods of drainage would be valuable: for example, in excavations in very soft soil and as a temporary measure in the control of slips on earth slopes. The following discussion draws attention to a relatively little-known method of draining soils where ordinary methods would not be possible. This method is based on the electrokinetic phenomena.

At the beginning of the nineteenth century, F. F. Reuss conducted several experiments which represent the first recognized observations of the processes that have since been termed the "electrokinetic phenomena." It was observed that water migrated toward the cathode when a direct current potential difference was imposed across a clay or fine quartz layer. In 1809 it was found that clay particles in a water suspension carried an effective negative charge, and were thus drawn to the anode of a direct current field. These processes constitute two of the four electrokinetic phenomena and have been named "electro-osmosis" and "electrophoresis" respectively. It was evident that these processes were dependent upon some potential differences existing at the interfaces of a two phase, solid-liquid system.

In 1859 G. Quincke observed that the streaming of a liquid under hydrostatic pressure through a diaphragm produced an electric potential difference across the diaphragm. Obviously this effect is the converse of electro-osmosis; it is designated by the term "streaming potential."

Since an electric potential gradient induces the movement of clay particles in suspension, it might be expected that the converse phenomenon — the production of an electromotive force by the mechanical movement of particles in suspension — might exist. In 1878 E. Dorn conducted experiments which showed the existence of this process, which is the opposite of electrophoresis and is termed "sedimentation potential."

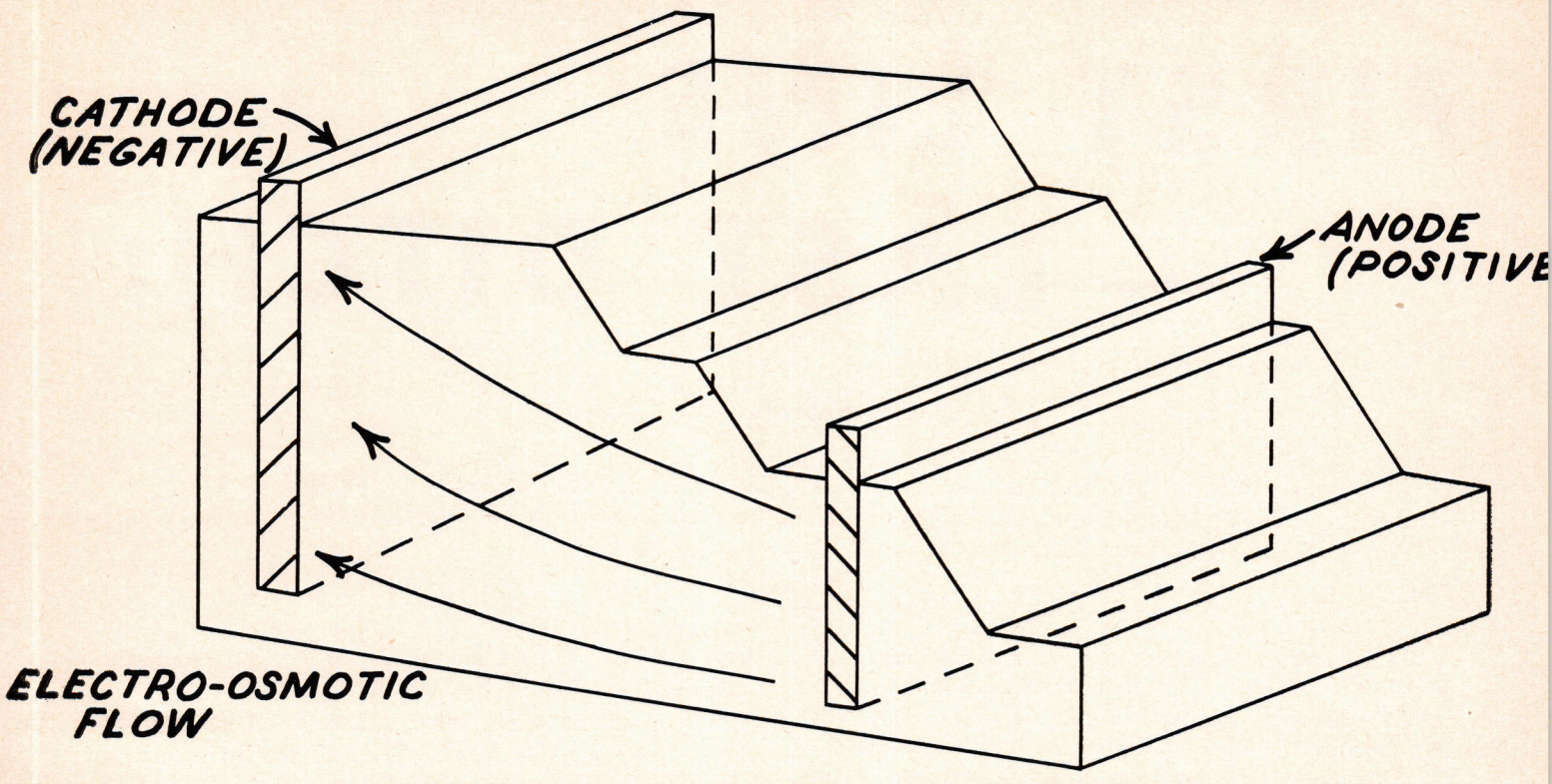
The first seventy years of experimentation on these phenomena were devoted to classifying them, interrelating them, and formulating approximate empirical expressions describing them. It was not, however, until 1879, when H. Helmholtz published his analysis of electro-osmosis, that the electrokinetic formulas were shown to follow from the fundamental equations of hydrodynamics and electrostatics. Helmholtz's equations have seen impressive experimental confirmation and are generally compatible with the recent concepts of the mechanism involved in these processes. The fundamental research on electrokinetics from Helmholtz's thesis to the present day has been concerned with:

(1) confirming the general form of Helmholtz's equations,
(2) modifying the rigid double layer concept in favor of the diffuse double layer as an explanation for the electrokinetic interface potential,
(3) developing techniques for determing the values of the parameters in Helmholtz's equations, and
(4) applying modern concepts of physical chemistry to explain certain anomalies which developed in experiments illustrating the Helmoltz equations.

As noted earlier, an electrical potential difference exists at the boundary of two phases. At a solid-liquid interface this potential difference was conceived by Helmholtz to lie in a rigid electric double layer much like that assigned to a flat plate condenser. A characteristic feature of the electrokinetic phenomena is that when one phase is displaced mechanically along the boundary of another phase, the movement is accompanied by a coexisting electromotive force. Since it is the only case which is involved in soil drainage, only the solid-liquid system will be considered here.

The electrokinetic phenomena may now be conveniently classified as follows:

(1) an applied electromotive force produces motion:
    (a) of a liquid against a solid—*Electro-osmosis.*
    (b) of solid particles against a liquid—*Electrophoresis.*
(2) an externally caused motion produces an electromotive force:
    (a) when the liquid is moved relative to the solid surface — *Streaming Potential.*
    (b) when the solid body is moved relative to the liquid — *Sedimentation Potential.*



EXCAVATION WITH ELECTRO-OSMOSIS

The basic electro-osmotic process.

To explain the principle of electro-osmosis it is necessary to review briefly certain other phenomena of physical chemistry.

In 1807 Reuss discovered that if an electric potential is applied to a porous diaphragm, the water moves through the capillaries towards the cathode; as soon as the electric current is switched off, the flow of water stops. In 1879 Helmholtz explained this phenomenon and provided a mathematical basis which, with slight modification, is still accepted.

In a cylindrical capillary tube filled with water we must distinguish, according to Helmholtz, between free Water and a boundary film of water immediately adjacent to the wall of the capillary. He called this film "double layer" because he assumed the existence of opposite electrical charges on two layers forming together the double layer. One part of the double layer, which is very thin compared to the total thickness and which normally carries negative charges, is rigidly attached to the wall. The much thicker inner part of the double layer, which carries the positive charges, was termed by Helmholtz the movable part, because if an electric potential is applied, the positive charges move toward the negative pole. In doing this, they drag along the water molecules of the movable part of the double layer.

The cylinder of free water inside the capillary, which is completely enclosed by the double layer, is dragged along by the movable part. If we assume that no other forces are acting upon this cylinder of free water, its rate of flow will be constant. The phenomenon just described is known as electro-osmotic flow.

In comparison to the electro-osmotic flow of water, ordinary flow of water through fine capillaries is laminar flow with zero velocity along the wall and a parabolic velocity distribution. When referring to a zero velocity along the wall, we mean, strictly speaking, along the inside surface of the double layer. Since this layer, which is held immobile by molecular forces, is extremely thin, the velocity along the wall is, for practical purposes, zero.

In soil mechanics, the existence of a very thin immobile layer of water next to the wall, not participating in the movement of water under a hydraulic gradient, was recognized by Terzaghi in 1925.

With these considerations in mind, the velocity distribution for hydraulic flow through a capillary is a parabolic form. Strictly speaking, even this is not quite correct because, as a result of the movement of the water, a flow of electricity is generated in the double layer; and for this reason the actual velocity distribution is complicated. However, when considering hydraulic seepage through coarse capillaries, one may assume zero velocity within the entire double layer.

Numerous investigations based upon these considerations have been carried out to determine what use may be made of these phenomena in the problems stated earlier. These investigations have demonstrated to what extent and in which instances the processes are practical. As the pores in the soil increase in size, the galvanic current, which causes electrolysis, becomes greater and greater as compared with the electro-osmotic current, so that from the viewpoint of electrical drainage, most of the current is wasted. The limit of usefulness of the method apparently lies somewhere between 0.1 and 1.0 mm.

During the war, a quick, effective method of drainage where foundation conditions were

(Please turn to Page 28)

FIRST LINE — LAST DITCH:

By Robert McArthur, B.S.E., '59

ROBERT McARTHUR presents here his first article for MECHELECIV. He is quite able to present the subject of guided missiles, for while in the Army he spent two years working with them.

As the average Washingtonian reads of the latest and most ferocious advances in atomic warfare, he can hardly be blamed for feeling just a bit like a fly on a bulls eye. To judge by the scare stories in the daily newspapers, vaporization is just a matter of time, and any freak types who manage to avoid it are only prolonging their misery.

The civil defense picture, however, is not nearly as black as it seems, and one of the brightest spots in it is the Nike surface-to-air guided missile, represented in the D. C. area by the 36th, 71st, and 75th Antiaircraft Missile Battalions. Recently shifted to permanent installations from their temporary quarters at Fort Meade, Virginia, these were among the first batteries set up in this country.

Nike herself, named after the Greek goddess of winged victory, is a sight familiar to most Americans today: tall, white, and shark nosed, her picture has become common fare in our national news magazines since the Department of Defense took the lid off her, back around appropriations time, 1953. Moreover, she is one of the most popular exhibits at most Armed Forces Day shows; for those who are interested, she may currently be seen on the Fort Myer parade grounds, rendered thoroughly harmless and accompanied by the Corporal surface-to-surface missile, her comrade-in-supersonic -arms.

Despite her relative familiarity, though, Nike remains an enigma to most Americans. Still shrouded in secrecy, her capabilities are seldom fully understood even by the men who service her. And yet, Nike may be the cause of a revolution in warfare at least as great as that brought on by the introduction of nuclear weapons; there is considerable reason to suppose that she and her descendants may render air attack in any form futile.

The Nike, however, did not spring full grown from the brow of Charlie Wilson. As long ago as the end of World War II, military authorities realized that some radically new weapon would be necessary to meet the unparalleled defense problems posed by the introduction of the atomic bomb.

Basically, the problem raised by the bomb, and intensified by its alphabetical successors, was one of a statistical nature. Previously, antiaircraft defenses had been considered excellent if they managed to destroy as many as 5% of the attacking enemy planes in any one raid; the R. A. F. ended the London Blitz of 1940 by inflicting such a casualty rate on the German Luftwaffe. With nuclear weapons, however, anything with less than a 100% kill rate is useless; of all the attackers thrown against a city's defenses, only one bomber, only one bomb, need penetrate to render the defense futile.

It was to secure this 100% kill rate, or at least to approach it, that the Army Ordnance Corps dug from its files in 1945 an ancient proposal by the Antiaircraft Artillery Board. Dated January, 1944, the paper pointed out that, as bombers flew higher and higher, it was becoming almost impossible to reach them with conventional artillery fire; in addition, the greater speeds of aircraft then under development would make tracking and hitting the target more a matter of controlled miracle than of skill.

In view of these facts, the paper suggested that it might be a good idea to investigate the possibility of developing a "controlled antiaircraft rocket projectile," and listed the things such a device would have to be able to do to be of use to the Army.

This proposal was sent to the Bell Telephone Laboratories for analysis. There, a "paper study" was carried through and, within five months of the receipt of the document, the Bell Laboratories submitted their solutions of the problems involved.

Basically, they proposed a two part rocket with an intricate radar guidance and control unit directing it from the ground. The lower part, or "first stage," of the rocket was a solid fuel unguided booster unit of tremendous thrust and short burning time, designed to carry the missile as rapidly as possible to a "hunting" altitude. This lower stage was to drop away when expended and leave the upper stage to proceed at supersonic speeds on its own liquid fuel propulsion system. The upper stage, containing in addition to its own motor the guidance unit and the warhead, would then proceed under the direction of the ground guidance system to intercept and destroy its target..

The Nike

The suggested device looked feasible, and a development contract was made with Bell Laboratories to supply the guidance system they had proposed. Simultaneously, another contract was granted to the Douglas Aircraft Company for the development of a suitable airframe and power plant.

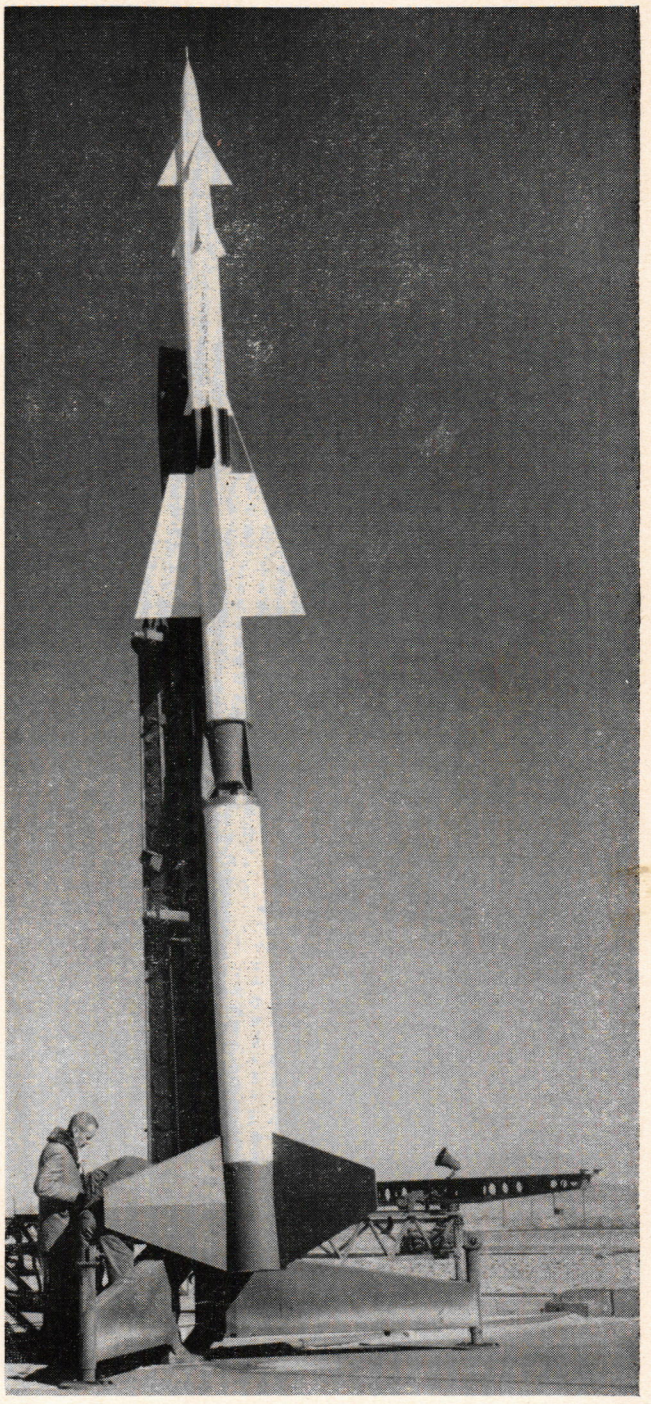
Within six months, the first test vehicle was fired at the newly established White Sands Proving Grounds, in New Mexico. By fall of 1946 the aerodynamic portion of the missile had met the requirements set forth by the original Antiaircraft Artillery Board directive, and had surpassed them by a considerable margin. Using a canard type wing plan, with the fins set ahead of the wings, the missile was at the same time more maneuverable and far, far faster than the best aircraft then on the drawing boards.

The guidance system, however, took much longer, embracing as it did the contents of several trailers of moving van size, as well as the actual airborne control unit. It was not until late in 1951 that the missile in a form substantially the same as that it has today was successfully flown.

The firings of the completed system were so successful, however, that the Army Ordnance Corps immediately expressed its satisfaction, and contracted with Western Electric for the mass production of this new weapon; meanwhile, it proceded to train the men and to buy the land necessary to erect a ring of fortifications around every major city in the United States.

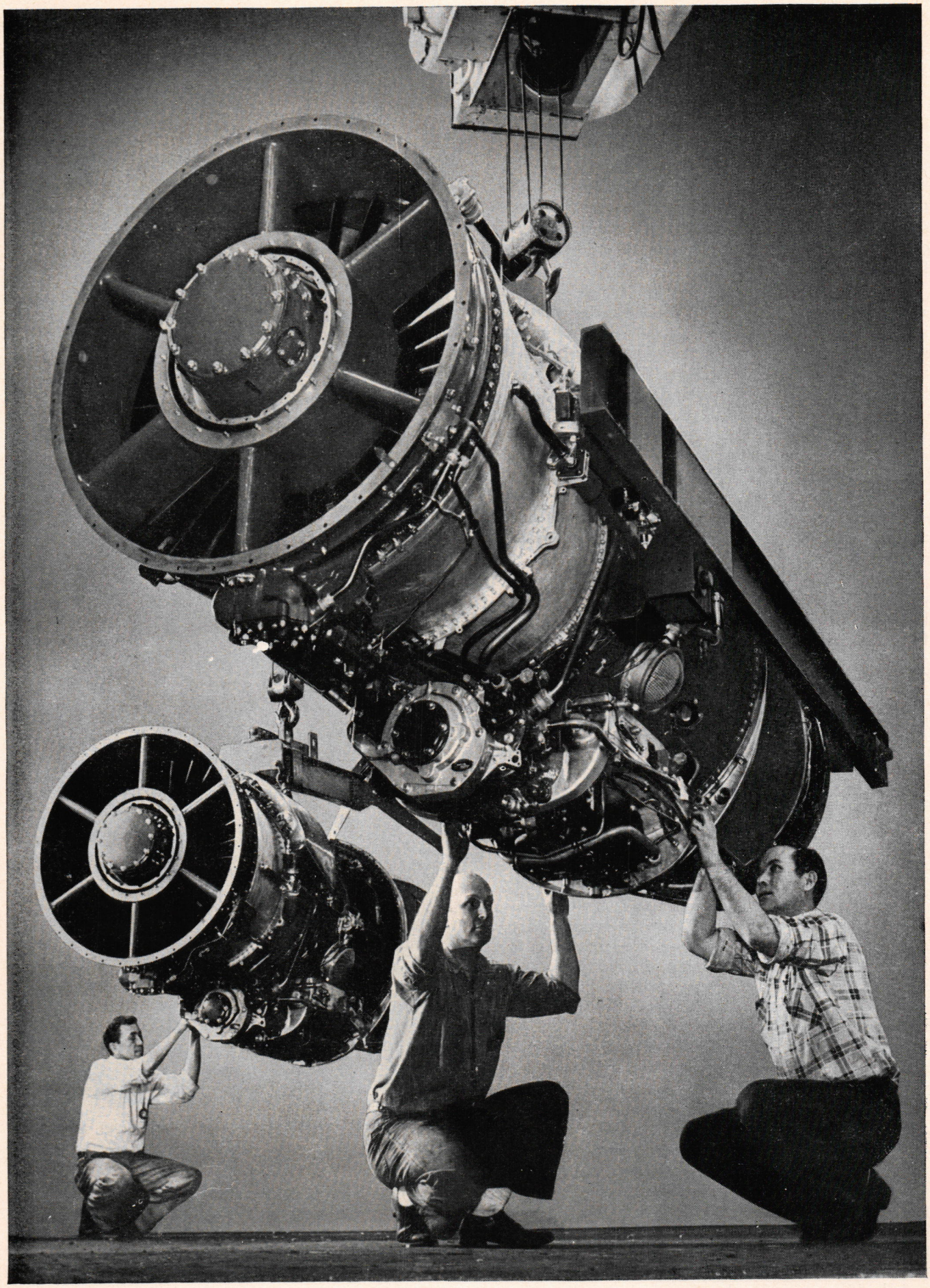
The Nike as it now stands is a last ditch weapon, the last line of antiaircraft defense. In case of attack, the Washington batteries, for instance, would be alerted by the regular Air Force Warning Network; they would get their crack at the enemy only after his planes had penetrated to the very brink of their objective. But a 100% effective last ditch weapon is as good as a 100% effective first ditch one, and while one might prefer to have enemy bomber fragments raining to earth just a bit farther from the city limits, the present system is a considerable improvement over its ineffectual predecessors, wherein the city limits were pelted with the city.

It is as the first example of a new type of weapon, however, rather than as a final answer in itself, that the Nike is interesting. It is, of course, hard to predict exactly how the weapons of the next war will work out in practice, but it is fairly safe to assume that the day of the manned combat aircraft is about over. The pilot of a modern jet fighter is fast becoming a liability; modern jet planes take off, fly the mission, fire on the enemy and return almost without human intervention, and the necessity for carrying along oxygen and safety equipment for the pilot, from G suits to landing gear, as well as the necessity for limiting the maximum acceleration, therefore the maneuverability of the plane in order to avoid reducing him to a raspberry mush, are extracting an awfully high price for the comparatively minor functions that the pilot carries out.

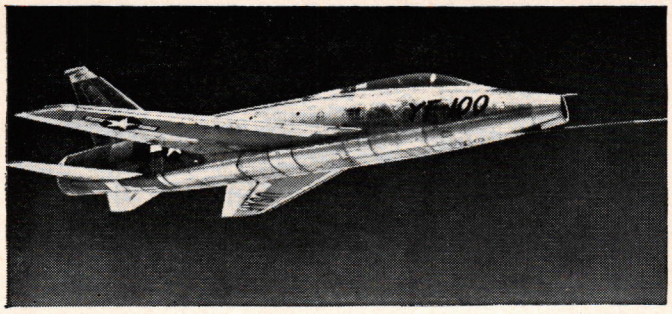


Typical Nike installation, showing rocket and launching stand. ***—U.S. Army Photo.***

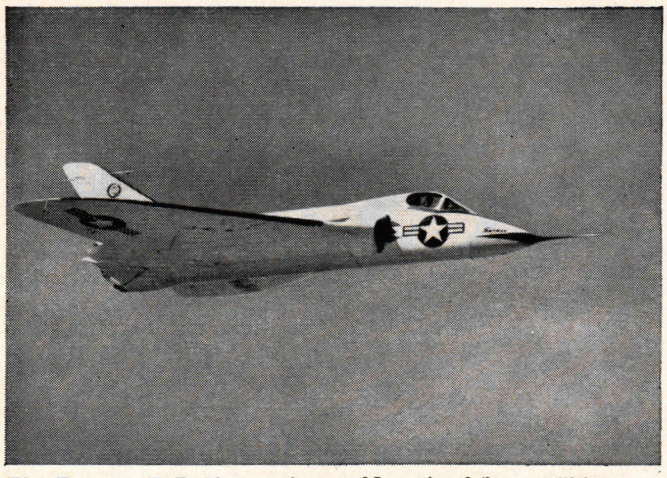
This, of course, is a common story today. More and more we find that man becomes superfluous and his machines replace him. But surely, there is no place that one could wish to be more superfluous than on a battleground.



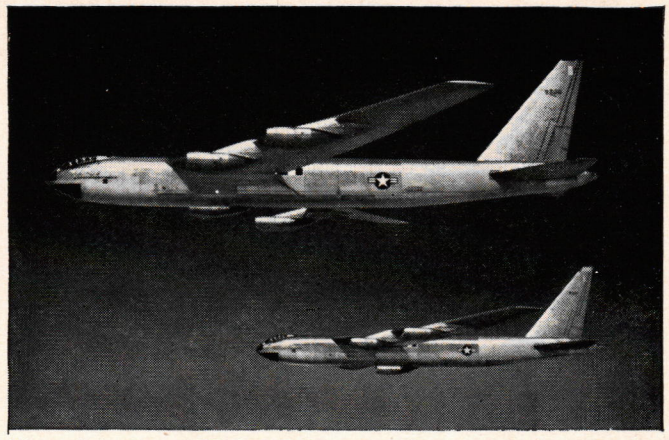
The J-57, in the 10,000-pound thrust class, is the most powerful turbojet engine now in production. A new generation of U.S. air power has been designed around this mighty new Pratt & Whitney Aircraft engine.



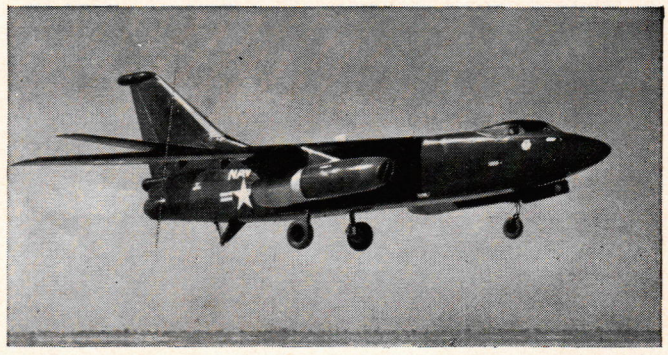
North American's F-100 Super Sabre, fastest Air Force jet fighter, is powered by Pratt & Whitney Aircraft's J-57 engine.



The Douglas F4D Skyray, fastest Navy jet fighter, will be powered with the big J-57 engine.



First all-jet heavy U. S. Air Force bombers are the huge Boeing B-52s, powered by eight J-57s mounted in pairs.



The Douglas A3D, the Navy's most powerful carrier-based attack airplane, has two J-57 engines.

Blazing the Way for a New Generation of Air Power

The most powerful turbojet engine in production is blazing the way for a whole new generation of American aircraft.

That engine is Pratt & Whitney Aircraft's J-57, the first turbojet to achieve an official rating in the 10,000-pound thrust class.

But the J-57 provides far more than extreme high thrust. Its unique Pratt & Whitney Aircraft design, achieved after years of intensive research and engineering, offers as well the low specific fuel consumption so vital to jet-powered bombers and future transports, plus the additional important factor of fast acceleration.

The importance of the J-57 in America's air power program is clearly shown by the fact that it is the power plant for three of the new "century series" fighters for the U. S. Air Force—North American's F-100, McDonnell's F-101 and Convair's F-102—as well as Boeing's B-52 heavy bomber. The Navy, too, has chosen the J-57 for its most powerful attack aircraft, the Douglas A3D, the Douglas F4D fighter and for the Chance Vought F8U day fighter. And the J-57 will power the Boeing 707 jet transport.

The J-57 is fully justifying the long years and intensive effort required for its development, providing pace-setting performance for a new generation of American aircraft.

Engineering graduates who can see the challenge in this new generation, might well consider a career with the world's foremost designer and builder of aircraft engines.

PRATT & WHITNEY AIRCRAFT

DIVISION OF UNITED AIRCRAFT CORPORATION

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Safety

(Continued from Page 11)

when properly utilized, can help to determine the necessity for concentration of effort into certain aspects of the over-all program.

Another sub-program is an adequate and equitable awards program. A nice certificate, a lapel pin, an engraved pencil, or simply a "pat on the back" for a job well done can go a long way towards making the over-all program a success. An awards program should be very carefully planned, however, for this is an area where dissension and crticism can result with relative ease.

Then, of course, there is the constant problem of safety promotion. This can be accomplished by the use of such devices as posters, movies, pay-check enclosures, plant publications, and attractive safety stickers. Each bit of promotional material should carry an important message in such a manner that it will be accepted. Safety promotion is a continuing program. It has been stated that accident prevention is like putting pressure on a coiled spring. Release the pressure, and you're back where you started. Safety is a result of expert, tight administration.

Probably because of the many diversified aspects of safety and the few qualified personnel in the field, there are not many young people in accident prevention work. Less than ten colleges and universities in the United States offer extensive training in safety, so this means there is great opportunity for graduate engineers. The field offers many chances for contributions towards saving the lives and limbs of literally thousands of fellow Americans.

Work in safety affords excellent training in administration, selling, program development, and design of technical devices such as machine guards and protective equipment. Development and administration of a safety program require long range planning and the ability to "sell" an intangible product. Design of guards and protective equipment requires full knowledge of the technical aspects of the operation. No guard or equipment can in any way interfere with or impede the operation for which it is being designed.

Safety is working with people, all with different backgrounds and different personalities. The job is to encourage them to do what they ordinarily should do - - work safely. Although this sounds very simple, it certainly is not, as evidenced by the tremendous number of industrial injuries each year. The two major foes of the safety engineer, or director, are complacency and improper training or indoctrination, but whatever the reason it is a dangerous attitude. There are many employees performing jobs for which they have not been properly trained. There are usually several ways to get a job done, but the safe way is the only right way. It is the responsibility of the safety engineer to see that all supervisors properly train their personnel. Safety engineers are striving to condition the individual so that he will react safely to situations in which danger is an element; so that, in short, safety becomes a habit.

Safety should be the individual responsibility of everyone, not only the company, management, foremen and supervisors, but of the entire working force. Individual responsibility is basic to all functions requiring cooperation among men and women, and there is no acceptable substitute. Safety then, is the responsibility of every engineer, whether he is safety engineer or mechanical engineer or civil engineer or electrical engineer.

Although few colleges and universities offer extensive training in safety, more than 350 offer courses in general safety or driver education or both. New York University has a Center for Safety Education which gives both degree and non-degree courses in safety. They have a large non-degree program in traffic safety, with regular evening courses and numerous short courses for fleet safety men, teachers, police officers, and community leaders. NYU offers 19 courses in industrial safety and gives a certificate in industrial safety for completion of 11 of these.

Industry has organized many in-service training programs. At every level, training is carried on in the management of safety programs, on supervision for safety, and in working safely. They are moving in the right direction, but they need to be expanded, especially to the great number of smaller plants.

The goal in industrial safety should be a broad program of education at the college level, coordinated with the high schools of the country and with industry, to the end that American industry may be supplied with men and women with knowledge, skills, and attitudes of safe work.

The schools, colleges, and universities cannot effectively accomplish the entire job of safety education. They should not be expected to for there are immense resources for safety training and education which exist outside the centers of formal education.

Perhaps the greatest of these is the National Safety Council, with its affiliated councils and its relationships with other agencies. In a broad sense, it is itself a great educational institution. It is the coordination agency for many industries, associations, and safety groups, whose total program can achieve maximum impact.

Safety is not just the training of a physical reflex in driving, or dissemination of promotional materials, or any other single aspect of the entire program; it is the conditioning of every individual to function safely as a matter of course, as a habit.

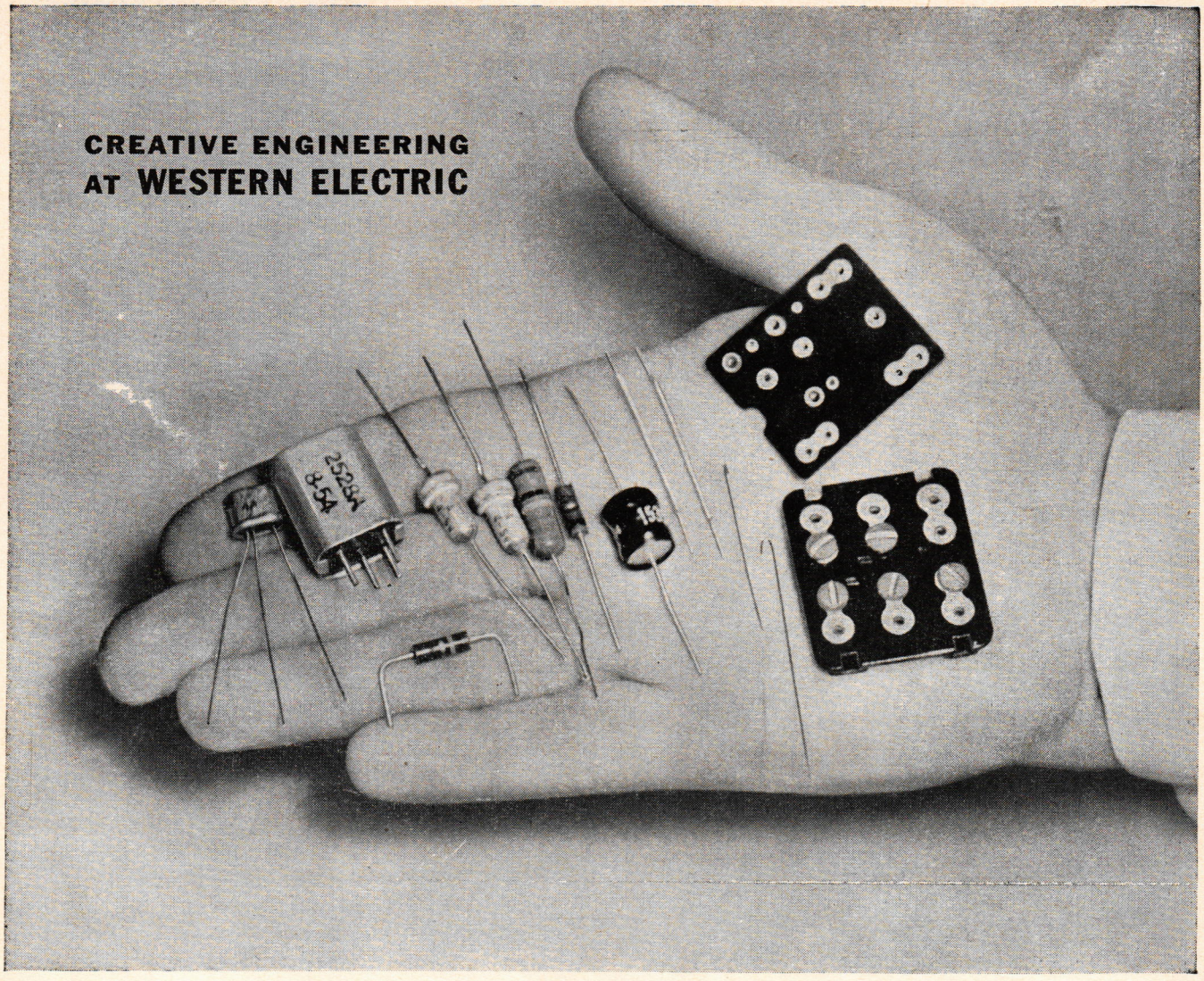
Accidents are, by definition, unnecessary and can, by definition, be prevented. They are economically wasteful and can be disastrous in terms of human suffering and loss of life. The job that we all face is, through combined effort and education, to continue to reduce the number of accidents in all human activities and to make this a safer, and better, nation.

WHAT WOULD YOU HAVE DONE?

While trying to take a truckload of darbpunching jigs 14 feet high through a tunnel 13 feet 11 inches in clearance, a driver for the North American Clamp-Stamping Corporation of Pawtucket, Rhode Island, found himself stuck. Unable to go either forward or backward, the driver left the truck jammed in the tunnel and phoned the company transportation engineer, who solved the dilemma in an ingenious fashion.

What would *you* have done? did he do?

(See answer on page 26)



Use of the transistor in Bell telephones

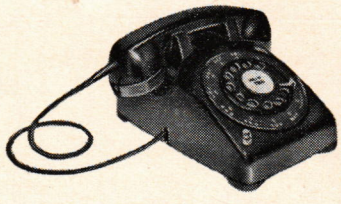
Shown here are the parts of the small amplifying unit in Western Electric's new Volume Control Telephone.

Because of the use of a transistor (shown above, extreme left on index finger) this amplifying unit is no larger than an ice cube and can fit inside the housing of a standard telephone.

Manufacturing of transistors on a commercial basis represents a solid engineering achievement... for it means volume production of an item that must be made under rigidly controlled laboratory conditions. For example, harmful impurity atoms in the germanium must be reduced to less than 1 for every 10,000,000,000 germanium atoms and then helpful impurity atoms added until there is approximately 1 for every 50,000,000 germanium atoms.

Western Electric has been making transistors since 1951 when our engineers set up the first commercial production line. This history-making achievement is representative of the way we work as the manufacturing unit of the Bell System... translating Bell System designs and inventions into the many things—from tiny semi-conductors to huge switching systems—used in the nationwide Bell telephone network.

It's a job that presents an unending challenge to our engineering staff.



VOLUME CONTROL TELEPHONE: A twist of control knob increases listening volume... a boon to those who have difficulty hearing.

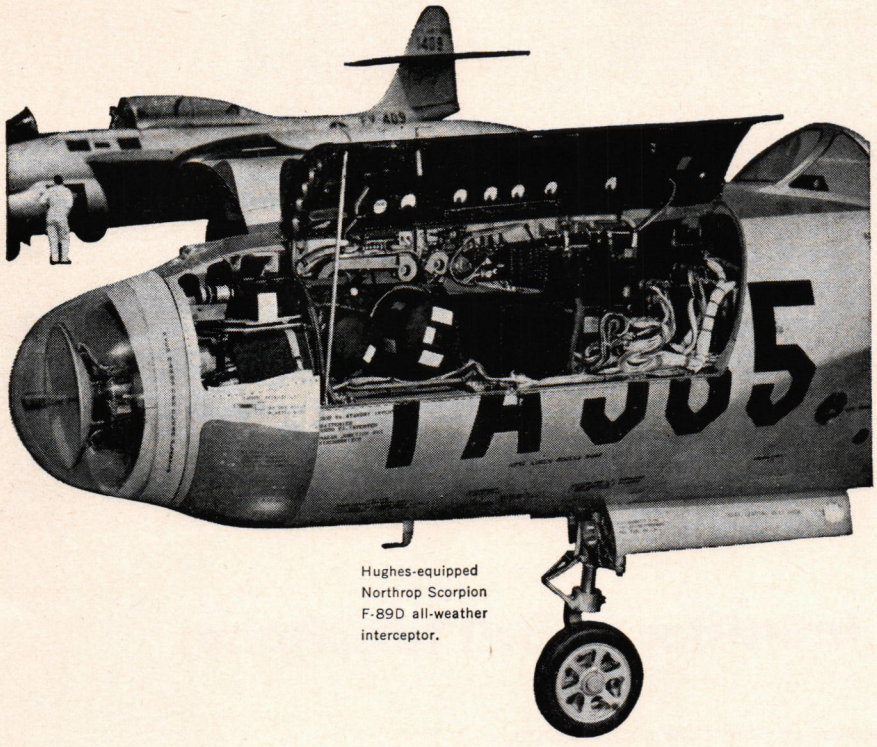
Western Electric

MANUFACTURING AND SUPPLY UNIT OF THE BELL SYSTEM

Manufacturing plants in Chicago, Ill.; Kearny, N. J.; Baltimore, Md.; Indianapolis, Ind.; Allentown and Laureldale, Pa.; Burlington, Greensboro and Winston-Salem, N. C.; Buffalo, N. Y.; Haverhill and Lawrence, Mass.; Lincoln, Neb.; St. Paul and Duluth, Minn. Distributing Centers in 29 cities and Installation headquarters in 15 cities. Company headquarters, 195 Broadway, New York City

Use Your Military Training

The time was never more opportune than now for becoming associated with the field of advanced electronics. Because of military emphasis this is the most rapidly growing and promising sphere of endeavor for the young electrical engineer or physicist.



Hughes-equipped Northrop Scorpion F-89D all-weather interceptor.

E.E. *or* PHYSICS GRADUATES

with experience in

RADAR *or* ELECTRONICS

or those desiring to enter these areas...

Since 1948 Hughes Research and Development Laboratories have been engaged in an expanding program for design, development and manufacture of highly complex radar fire control systems for fighter and interceptor aircraft. This requires Hughes technical advisors in the field to serve companies and military agencies employing the equipment.

As one of these field engineers *you will become familiar with the entire systems* involved, including the most advanced electronic computers. With this advantage you will be ideally situated to broaden your experience and learning more quickly for future application to advanced electronics activity in either the military or the commercial field.

Positions are available in the continental United States for married and single men under 35 years of age. Overseas assignments are open to single men only.

Scientific Staff Relations

Hughes

RESEARCH AND DEVELOPMENT LABORATORIES

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DR. HECHTMAN

New C.E. Executive Head

Most students majoring in Civil Engineering have by now met the new executive head of the Civil Engineering Department, Dr. Robert Aaron Hechtman, but how much do you know about him?

To begin at the beginning Dr. Hechtman was born in Spokane, Washington. Since then he has amassed a B.S. in 1938 and an M.S. in 1939 in Civil Engineering from the University of Washington and a Ph.D. in Engineering in 1948 from the University of Illinois.

Dr. Hechtman has specialized in the field of Structural Design and is considered an authority on the problems of the Structural Design of ships. He has worked in this field for the Office of Naval Research and the National Research Council and during World War II he did research for the Navy.

He has written many articles on steel and reinforced concrete structures prior to coming to the University, he held the position of Professor of Structural Research at the University of Washington.

Today Dr. Hechtman is very busy trying to increase the number of graduate courses in order to eventually introduce a doctorate program in Engineering at the University. In addition he is working with the new two-year training program being offered at Annapolis

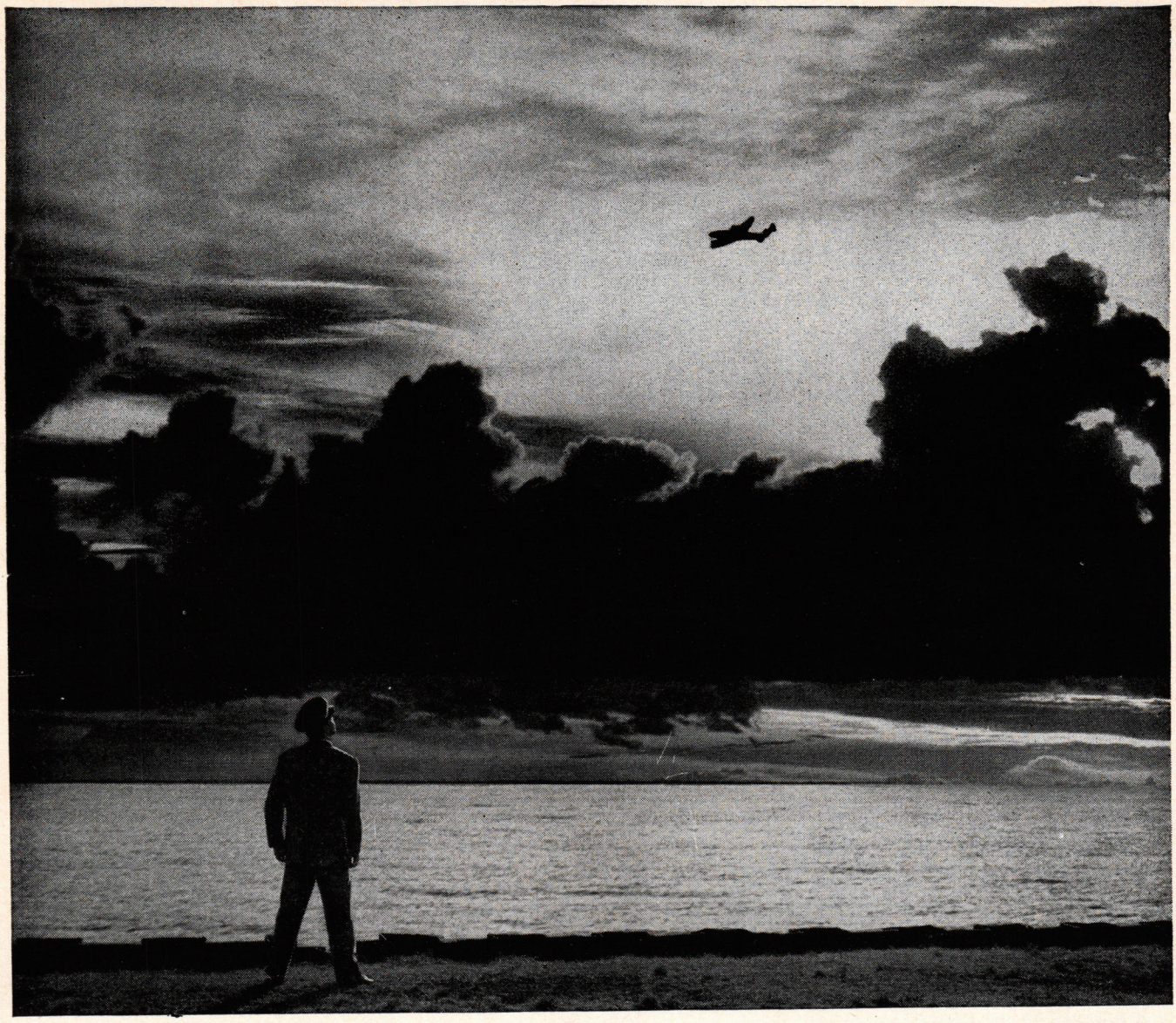
Besides his work at school Dr. Hechtman has two hobbies, music and model railroads.

He prefers classical music, has no favorite composers and has what he describes as a 'moderate' collection of records in his home in Langley, Virginia.

The hobby of model-railroading he shares with his two sons Geoffrey, 7, and Paul, 4.

Dr. Hechtman has served as a member of the Column Research Council, the Research Council on Riveted and Bolted Structural Joints and on the Research Committee of the American Concrete Institute.

Dr. Hechtman is a member of the American Society of Civil Engineers, the American Welding Society, the American Concrete Institute, Tau Beta Pi, and Sigma Xi.



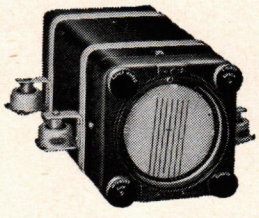
New RCA Radar "Weather Eye" Sees Through Storms

In our time, Man has won round after round in a contest against the elements that started thousands of years ago.

The most recent scientific victory is something new in Radar—an electronic "Weather Eye" developed by RCA.

In airplanes, this supersensitive instrument peers miles ahead. It gives advance warning of weather disturbances. The signals on its radar screen point the way to a safe course *around* storm areas, or even *through* them.

The leadership in electronic research that made the "Weather Eye" possible is inherent in all RCA products and services. And at the David Sarnoff Research Center of RCA, Princeton, N. J., scientists are continually at work to extend the frontiers of "Electronics for Living."



New RCA Weather Mapping Radar weighs under 125 pounds, takes little space in a plane.

For information regarding design and development engineering positions on such projects as "Weather Eye" Radar and military electronic equipment—write to Mr. Robert Haklisch, Manager College Relations, Radio Corporation of America, Camden 2, N. J.

RCA®

RADIO CORPORATION OF AMERICA

ELECTRONICS FOR LIVING

OUT OF THE BRIEFCASE

ASME'S 75th YEAR

A month ago this week the ASME celebrated their Diamond Jubilee via their annual meeting. The Chicago section played host this year.

A timely set-up was the schedule of the Chicago Exposition of Power and Mechanical Engineering in conjunction with ASME's meeting. A new feature was added to the exposition: an atomic power section, organized to show applications of atomic energy to power of special interest to mechanical engineers.

The Annual Meeting highlighted the year-long celebration of the Society's 75th year. Special emphasis was placed upon all the major phases of the mechanical engineering field with over 300 discussions, lectures, and trips. Spotlighted panel discussions were, "The Economic Aspects of Technology" and "The Engineer and the World of Commerce and Industry."

Copies of most of the technical reports presented are available upon request to ASME.

"DEW" LINE RADAR

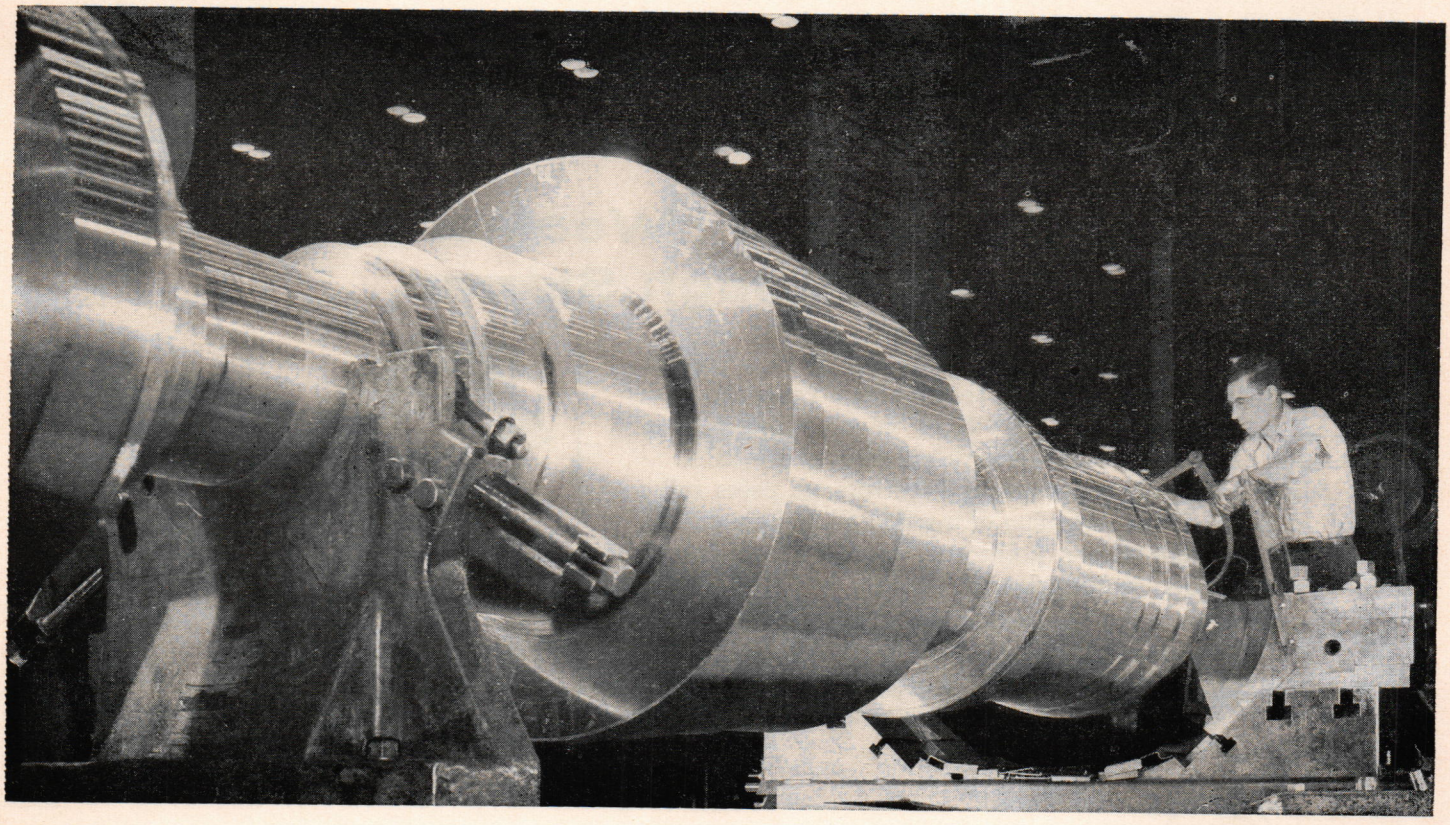
The Distant Early Warning system now being built across the northern rim of the western world, is a joint defense operation of two nations, Canada and the United States.

In concept, design, construction and execution, the DEW line will be a major engineering achievement. The DEW line is the popular term for a picket-fence network of radar stations whose purpose is to guard against sneak air attacks via the short and direct polar routes. The industrial heart of America is considered a prime target of any attack and the electronic sentry system will offer several hours warning—priceless time if "Condition Red" is ever sounded.

Completed, the DEW line will stretch across Canada from Alaska to Greenland with all station sites inaccessible except by air. A maze of permanent settlements is being built in the frozen wilderness, another complex problem of logistics and engineering. There is a problem of construction on the Perma-frost. No heat from buildings can be allowed to penetrate the earth's surface, for an unbalancing of its temperature might cause the earth to settle badly. In construction areas of the DEW line winds are sometimes greater than 100 miles per hour and temperatures as low as 50°F below freezing are not an exception.

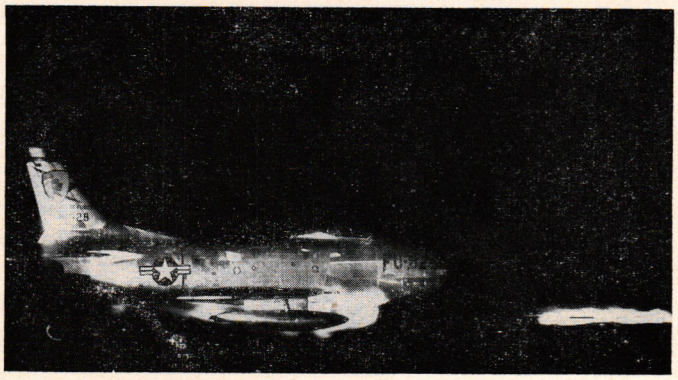
The DEW line must also conserve manpower wherever possible. This is being accomplished by the use of unmanned stations and automatic equipment wherever practicable. Here is engineering where equipment must be designed to operate faithfully around the clock with an absolute minimum of maintenance.

The DEW line project is a noteworthy example of cooperation between governments, armed services, and civilian enterprises. Some techniques developed for this work were unknown even three years ago and will serve the public some day, upon release from security restrictions.



Among the world's largest is this rotor for a steam-turbine generator shown being machined on a grooving lathe in G.E.'s Schenectady plant. The rotor itself weighs 23,000 pounds and the finished turbine will produce 260,000 kilowatts.
General Electric Photo

IN INDUSTRY



JET TO JET FLASH

The first jet-to-jet flash picture ever taken used the world's tiniest flashbulb for a light source. The photographer flew alongside the North American F-86D in a jet trainer; a General Electric M2 flashbulb was used for the shot. The F-86D Sabre Jet has just fired a rocket which is going over 2000 miles per hour.

Nuclear Helicopters

Dr. Igor Sikorsky, helicopter pioneer and aviation authority, has predicted a bright future for the transport helicopter in his lecture before the London Institute of Mechanical Engineers. Dr. Sikorsky, a Russian-born United States Citizen, received the Institution's James Watt International Medal in recognition of his contribution to engineering progress.

Development of the transport helicopter, he said will cover two main lines, for both military and commercial use: the airliner - transport helicopter and the freight and cargo carrier.

The passenger models will continue to resemble airliners in interior design, with only minor variations, such as larger doors and windows. Major changes, however, in the freight-cargo helicopter will result in a craft "with virtually no parallel in any other aircraft or even in any other vehicle of travel."

Advantages of using nuclear power are not certain because the helicopter is mainly for short-range flight. Dr. Sikorsky outlined several methods for using nuclear power for helicopters. Due to radioactivity the nuclear reactor and the turbine necessarily would have to be a considerable distance from the crew and passengers, and carried perhaps in a separate unit. Then again, it might prove more practicable to carry crew and passengers in a cabin suspended from the helicopter.

R.C.A. Photo

The closed-circuit television, which has become familiar in medical circles, is now being used to test experimental fishery methods for the U.S. Fish and Wildlife Service. The TV camera is housed in a water-proof bell on top of which there is a driving mechanism to rotate the camera.

OUT OF THE BRIEFCASE

ON CAMPUS

Scatter Symposium At G W U

DR. ALLEN B. DuMONT
Speaks at Scatter Symposium.

Specialists from all over the country assembled for a two-day "Symposium on Communications by Scatter Techniques" held on November 14 and 15 in Lisner Auditorium. The Symposium was sponsored jointly by the I.R.E. Professional Groups on Antennas and Propagation and Communications Systems and the George Washington University.

The Symposium was welcomed to the University by Dean Martin A. Mason. In the following technical sessions, papers were given dealing with scatter techniques, systems and experimental results. Highlighting the symposium was the talk by Dr. Alan B. DuMont, president of Alan B. Dumont Laboratories, Inc. Dr. DuMont outlined the progress of propagation by scatter techniques and pointed out that beyond the horizon broadcasting on UHF and VHF frequencies is now a distinct possibility.

Acting as liason agent between the I.R.E. and the George Washington University was William W. Balwanz, Lecturer in Electrical Engineering.

SIGMA TAU

On November 16, Xi Chapter of Sigma Tau pledged the following men at their regular meeting in Studio "A" of Lisner Auditorium: John H. Brandau, Damon C. Gray, Fred Hallberg, Orrin E. Kee, Donald J. Keever, Nathan Kronstadt, Morrow H. Moore, Jr., Saul M. Myers, James R. Owens, Bernard R. Segal, Earl S. Swann, Dominick Traina and Robert M. Weir. These men have been selected from the upper third of the Junior and Senior Classers, and have met the approval of the faculty and of the members of Sigma Tau.

Xi Chapter will hold their fall banquet and ball on December 10 at the Madison Arms, at which time the pledges will be initiated.

THETA TAU

Theta Tau celebrated Veterans' Day, November 11, with a shrimp feast held at Paul Kuzio's in Alexandria. The hungry members and guests consumed over forty pounds of shrimp prepared in the best of waterfront style by Chef M. V. Spencer. Along to provide tone to the singing were Sam Mawhood with his accordian and Bob Knowles with his guitar.

For those preferring more active picnic participation, a game of rough and tumble touch football brought out athletic ability where it was least expected. To quench their thirst from singing and running, the picnickers consumed twenty-three gallons of beer.

Although some thought the picnic to be a bit tame, the casualty list now includes cracked ribs and lacerated skin, not to mention two demolished watches.

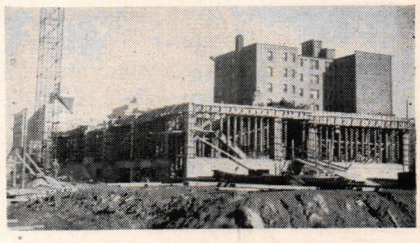
AIEE-IRE

The members of the AIEE - IRE chapter at their November meeting had an opportunity to expand their vocabularies to include the phrase *litterae patentes*. Mr. Frank H. Cullen, an alumnus of our Engineering School and local patent attorney for the Burroughs Corporation, explained the history of *litterae patentes* (or open letter) from the time of Queen Elizabeth to the present. It was interesting to learn that Lord Essex derived most of his income from a patent grant which made him sole supplier of Bordeaux wine to England.

Mr. Cullen very capably explained the meaning of a patent, the length of time it takes for an inventor to receive one, and the importance of a well-kept engineer's notebook. It was emphasized that in patent work one is necessarily concerned with the inventions of others, but the compensation could lie in the fact that those working in this field have an opportunity to possess a store of knowledge which is advanced two to five years over that of an outsider.

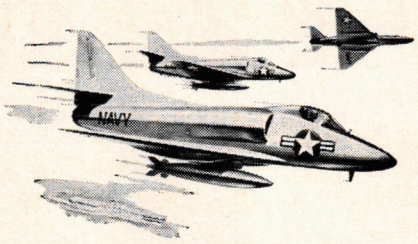
For their March meeting, the membership voted to sponsor the RCA color television demonstration. Mr. Cecil Hoyler of RCA has assembled the equipment for demonstration and accepted the invitation to show it at the George Washington University.

Since the stomachs of engineers, as well as the minds, become hungry, refreshments were served at the close of the meeting.



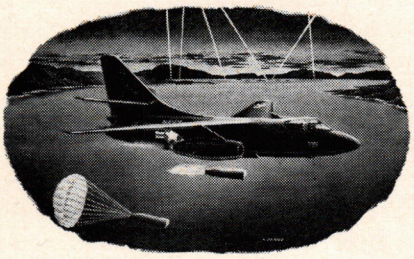
Tompkins Hall, showing forms for second floor. ***—Barwick Photo***

F4D, "SKYRAY"— only carrier plane to hold official world's speed record



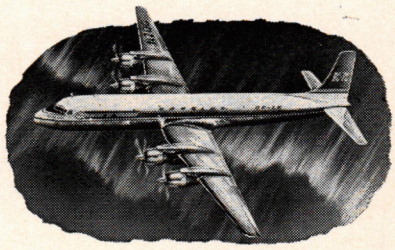
A4D, "SKYHAWK"— smallest, lightest atom-bomb carrier

RB-66 — speedy, versatile jet bomber



A3D, "SKYWARRIOR"— largest carrier-based bomber

C-124, "GLOBEMASTER"— world's largest production transport



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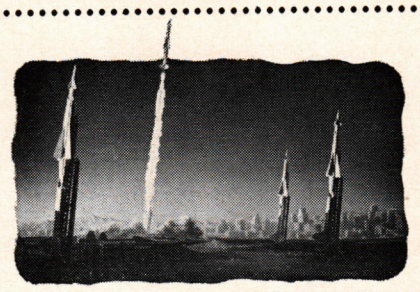
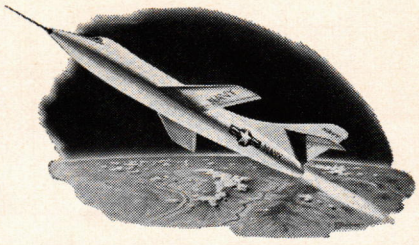


"NIKE"— supersonic missile selected to protect our cities



D558-2, "SKYROCKET"— first airplane to fly twice the speed of sound

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Counseling: The Helping Hand

(ED. Note). The Sigma Tau Counseling service is indeed unique, for it is a free service offered to students by the members of Sigma Tau. MECHELECIV has, within the last publishing school year, carried two articles on this service, and for those unfamiliar with the mechanics of it, presents this resume.

Around this time of year, there are many engineering students who are honestly asking themselves if there is any earthly reason for studying engineering. This doubt can usually be traced to one trouble: courses. Maybe things aren't going too well; the books don't make sense, the professors' lectures are above and beyond, and you should have taken Student Union 117 instead of Theory and Analysis of Shredded Grodniks. You, as a student, may feel lost and left-out in the seemingly hopeless maze of technical details, and you need help.

Let us examine the facts behind this situation; we may thus be able to arrive at a cure for your malady. You are not stupid, in fact you represent a rather diligent and intelligent breed of animal because you *are* in engineering. The mere fact that you have selected engineering as a profession makes you a sought-after individual in our present national economy. Then what can your problem be? You do study; you read the book and listen to the lectures. Your problem is probably that you really don't know how to attack this particular subject, or that you haven't acquired proper study habits. These are the most common causes of trouble that the Sigma Tau counselors have found.

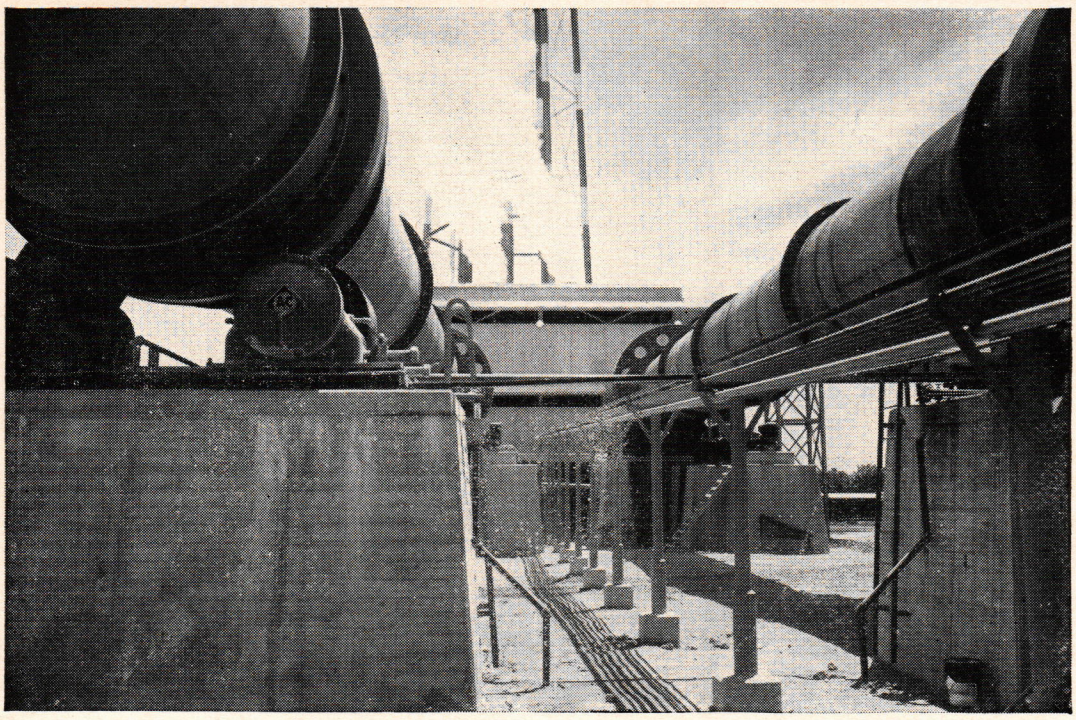
If you are having trouble, and feel that you need assistance, then you may apply for the Sigma Tau Counseling Service. There are but two steps in applying for the service: first you must want help, and second you must contact the service. You may contact Sigma Tau through the Dean's office or any Sigma Tau member you know.

A Sigma Tau tutor cannot substitute for a professor, but he can deduce your particular trouble. Perhaps you just need a more suitable place to study, or need help on some small detail that will clear up the whole subject. Whatever is needed, Sigma Tau will endeavor to provide it; tutors, extra reading material, or moral support can be obtained.

Remember that all you have to do to obtain this free engineering tutoring is to apply for it.

ANSWER TO— What Would You Have Done?

The transportation engineer moved a road crew out to the bridge and tore a hole eight feet in diameter through the arch; the truck was then disassembled and the components were hoisted through the hole with a twenty ton crane. The truck was reassembled on the other side of the tunnel, the driver was shot, and the shipment proceeded on its way after a mere six-month delay.



CONSTRUCTION— Tremendous rotary kilns, like these, typify Allis-Chalmers role in the cement industry.

Join the company that serves 3 GROWTH INDUSTRIES

Match your engineering talents to the future needs of the construction, power and manufacturing industries. These are growing needs—for the population is climbing at the amazing rate of 50,000 people every *week!*

Many billions of dollars for highway *construction* alone are called for by the President in the next ten years. Allis-Chalmers builds equipment used in making cement, aggregate and steel as well as earth movers and graders.

Electric *power generation* will double in ten years. A-C builds the machines that make electricity.

Manufacturing output must increase $3.5 billion by this time next year. Allis-Chalmers builds motors, control, drives and many other types of equipment for this industry.

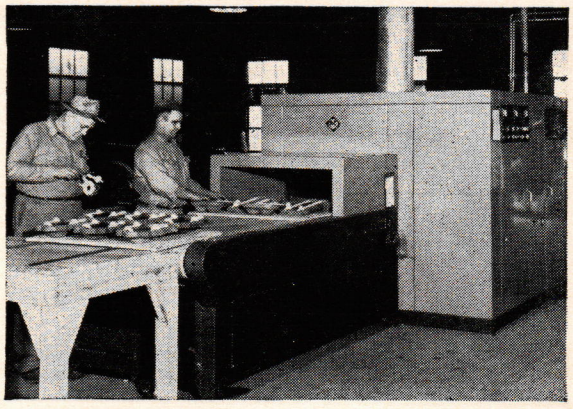
Here's what Allis-Chalmers offers to Young Engineers:

A graduate training course that has been a model for industry since 1904. You have access to many fields of engineering: electric power, hydraulics, atomic energy, ore processing.

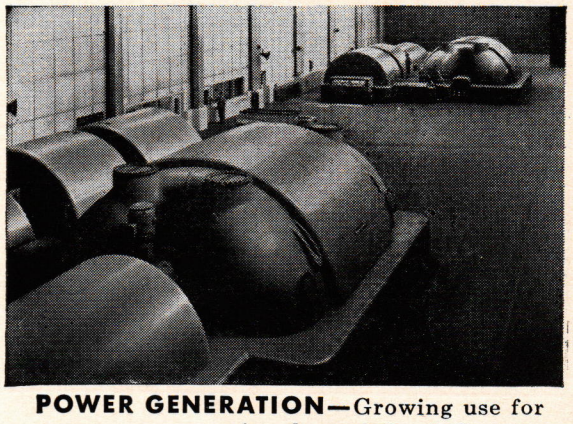
There are many *kinds* of work to try: Design engineering, application, research, manufacturing, sales. Over 90 training stations are available, with expert guidance when you want it. Your future is as big as your ability can make it.

Or, if you have decided your field of interest and are well qualified, opportunities exist for direct assignments on our engineering staff.

In any case—learn more about Allis-Chalmers. Ask the A-C manager in your territory, or write direct to Allis-Chalmers, Graduate Training Section, Milwaukee 1, Wisconsin.



MANUFACTURING—A-C aids high speed production and helps improve quality with dielectric sand core dryers like the one above.



POWER GENERATION—Growing use for power means growing demand for A-C steam turbines, transformers, and other equipment.

ALLIS-CHALMERS

A-468:

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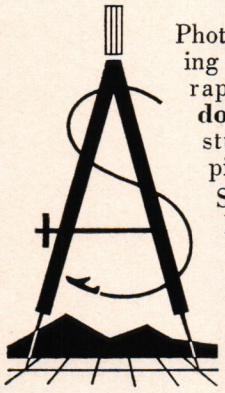

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Electroknetics

(continued from page 13)

bad became necessary. The Germans used electrical drainage on a number of large projects. For instance, it was used to make possible or to facilitate the excavation of railway cuts in the loess-loam of Salzgitter and in the silty sand of the Lerkendal Valley of Norway, to protect the sheet-piling walls of the U-boat pens near Drontheim, Norway (where foundation work was very difficult) from the danger of sliding and failure, and in the construction of bridges, etc., where soil conditions were unfavorable. During the war the English, too, began to study the method, and, in this connection, investigated the properties of various soils.

The outlook is very promising for the further uses of electrokinetic methods, not only in soil mechanics, but in other ways as well. Consider the numerous possibilities for soil improvement, through the acceleration of settlement or the local increase of shearing strength by drainage, and the consequent stabilization of slopes as a temporary or permanent measure. A study of how the method will affect landslides should be made. Moreover, electro-osmotic injection or grouting is possible. In the case of fine-grained soils whose slight permeability restricts the effectiveness of mechanical injection, the electro-osmotic method offers great possibilities. It increases considerably the radius of effectiveness, and the injected material may be guided in any desired direction.

The primary object of such injection is to form stable combinations — if possible such as occur in nature — by the use of very cheap, soluble salts. The cheapest and most effective combinations are yet to be found; our chemists and engineers should work together to discover them.

Other possibilities for the use of the direct current for soil consolidation which have been tried consist of replacing lightly attached ions, such as sodium, with ions which are more firmly attached chemically, such as aluminum, in bringing about mechanical consolidation of the grain structure of the soil. Attempts have been made to increase the bearing capacity of piles in this way by sheathing them with aluminum ions and then subjecting them to electrical treatment. It is possible that such reactions may be brought about by the above-mentioned injection method as well.

A secondary effect of electro-osmosis is change of volume. This is due to the lowering of the water content of saturated fine-grained materials. If the soil is very plastic, the compaction due to electro-osmotic action, (which may be compared with shrinkage), may be very great. Since the factors which bring about this volume change may be regulated, it should be possible to bring about a desired deformation. An interesting possibility is that clays and loams could be preconsolidated. Moreover, the rise of water in fine capillaries, which plays a role in the formation of ice lenses in the soil, as well as in the problem of drying damp walls, may be influenced by the electro-osmotic method under certain circumstances.

These methods, introduced in the last century but entirely ignored by engineers, open up broad new fields in soil mechanics.

ALUMVIEWS

PRESIDENT'S MESSAGE

By WARREN C. CRUMP

President, Engineers' Alumni Association

A challenging opportunity is being offered to graduates of the School of Engineering. Today, each engineer alumnus can demonstrate his pride in being "A George Washington Man" through the impending program of raising funds for the equipping of Tompkins Hall of Engineering, being sponsored by the Engineer Alumni Association.

As you know, through the generosity of Charles H. Tompkins the School of Engineering will soon have constructed a fine new home. The challenge now offered to engineer alumni is to contribute to the complete and modern furnishing of this new building.

According to Dean Martin A. Mason, $150,000.00 is needed to carry out this program. The Engineer Alumni Association, through its Executive Committee, has decided to devote its time and facilities in leading the way to a successful culmination of a fund raising campaign.

Engineer alumni will have an opportunity to contribute to this special Equipment Fund for the Tompkins Hall of Engineering through the Annual Alumni Fund of the General Alumni Association beginning in January 1956. Therfore, when you receive your Annual Alumni Fund announcement, I urged each engineer alumnus to designate your contribution for the special Equipment Fund of the Tompkins Hall of Engineering.

Furthermore, your personal assistance is needed in the contacting of fellow-alumni in behalf of this campaign. Won't you signify your partnership with us by calling STerling 3-0250, extension 306?

The Washington Alumnae Chapter of Sigma Tau has considered ways to remove some causes for the shortage of engineers and scientists in the nation. Discussions have been held with leaders in the field of man power and notably with Dr. Howard Meyerhoff, the Executive Director of the Scientific Manpower Commission, and Ralph Goetzenberger, Vice President of Minneapolis Honeywell Regulator Company. These meetings have resulted in a resolution which has been sent to the Chairman of the Armed Services Committees of the Senate and House of Representatives, and to the Maryland and Virginia Senators and Representatives, with a request to have the Resolution written into the Congressional Record. The Resolution is as follows:

RESOLUTION ON THE UTILIZATION OF TECHNICAL MANPOWER RELATIVE TO ACTS OF CONGRESS NOW IN EFFECT AND TO BILLS PRESENTLY UNDER CONSIDERATION.

WHEREAS there is at present a serious shortage of scientific and engineering personnel for military, industrial, and educational needs, which may become critical in the event of an emergency, and

WHEREAS the national interest requires that more emphasis and effort be directed toward increasing the supply of well-trained scientific and engineering personnel,

THEREFORE BE IT RESOLVED: That any program for selective service and the use of military reserve forces be such as to insure that technically trained perpersonnel be effectively used where they are most needed and of most value in the national interest; and That in determining where and when technically trained personnel would be most effective, the needs of industry, education, civilian government agencies, and civilian defense, together with the military be considered.

The Washington Chapter of the Alumni
Sigma Tau
W. J. Mayo-Wells, President
Herbert Rosen, Secretary

Replies were received from the Senate and House Committees. The new bill incorporated many of the ideas which Sigma Tau, in consultation with the Engineers' Joint Council, the Manpower Board and other similar bodies, had considered of great importance to the safety of our Nation.

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HELP!

We are in the dark. Where are our alumni? What are you doing? We haven't seen or heard a thing.

We need the facts on you, the people to whom this page is dedicated. The alumni receive the major portion of MECHELECIV'S circulation; so we want to read about the things you are doing. All we ask is a few lines on the form at the bottom of the page, at least. Of course, if you could write us a letter giving us much more news and views, so much the better. But, whatever you do, tear out the form below and mail it to us as soon as possible. Help lift the fog in Foggy Bottom. It's painless, try it.

ALUMNI NOTES

By the Alumni

HENRY AARON (BS inCE '28) former chief of Airports Technical Branch, Civil Aeronautics Administration, has been named highway and airport engineer of Wire Reinforcement Institute, Washington, D. C.

JOHN S. SHEIRY (BCE '37) is the new President of the New Jersey Association of Insurance Agents.

WILLIAM A WEIDEMEYER (BCE '55) has joined the engineering and research staff of Timber Engineering Company. He received the annual award of the ASCE in 1953 for an undergraduate paper on "Prestressed Concrete."

Dr. HAAREN A. MIKLOFSKY (BCE '46) has joined the Civil Engineering Faculty of Rensselaer Polytechnic Institute as a visiting associate professor. He was made a member of the Committee on Deflection Limitations of Bridges, a group named by ASCE.

CHESTER P. DAVIDSON (BME '50) a member of Sigma Tau, is working for the Long Island Lighting Co., where he has been employed for five years.

ROBERT H. VAN SICKLER (BME '55) worked with Pratt & Whitney in East Hartford, Conn., in Jet Engine Design. He is now under orders to report to Lackland Air Force Base in Texas for flight training. Bob was past editor of MECHELECIV, a member of Sigma Tau, Theta Tau and Omicron Delta Kappa.

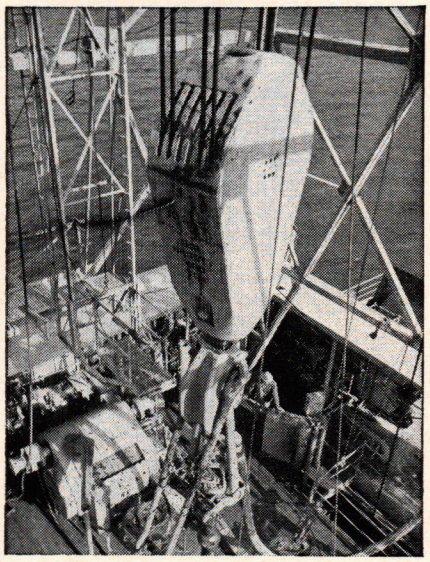
TO: ALUMNI EDITOR
Mechelecіv Magazine
The Davis-Hodgkins House
731 22nd St., N. W.
Washington 7, D. C.

From: ----------

Here are a few comments for ALUMVIEWS on where I'm working, what I'm doing and news of my family.

Degree and Date ---------- **Fraternity** ----------

Another page for **YOUR BEARING NOTEBOOK**



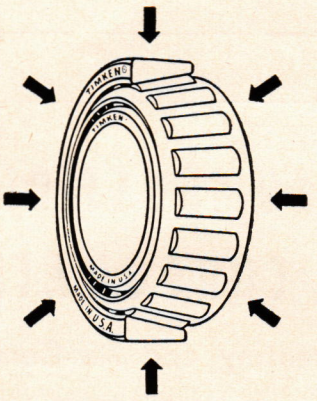
How to tackle heavy thrust loads in a 400-ton traveling block

Fleet angles set up a thrust problem on this oil rig traveling block. Engineers solved it by mounting the sheaves on Timken® tapered roller bearings. They keep the sheaves in positive alignment regardless of the fleet angle or line load, give the 400-ton capacity block maximum stability.

Timken bearings are designed to roll true, and precision-made to live up to their design. As a result, sheaves rotate freely and easily, even with a full weight of drill string, reducing line slippage and wear.

The taper in TIMKEN® bearings lets them take radial and thrust loads in any combination

Timken bearings are tapered to take thrust loads as well as radial loads, or any combination. And Timken bearings can handle heavy loads because (1) they have full line contact between rollers and races. And (2) the rollers and races have shock-resistant cores under hard, wear-resistant surfaces.



Want to learn more about bearings or job opportunities?

Some of the engineering problems you'll face after graduation will involve bearing applications. For help in learning more about bearings, write for the 270-page General Information Manual on Timken bearings. And for information about the excellent job opportunities at the Timken Company, write for a copy of "This is Timken". The Timken Roller Bearing Company, Canton 6, O.

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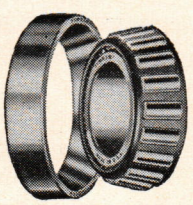

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From The Editor's Notebook

The most apparent change in this month's issue is its size: MECHELECIV is thirty-two pages big for the first time. This could not have been done without full cooperation and just plain hard work on the part of the staff.

The tanks on this month's cover are an original idea of one of the newer members of the MECHELECIV staff: *Sheila Lane*, artist. Sheila was originally introduced to MECHELECIV through Pat O'Neil who is now in charge of industry news for Out of the Briefcase. When asked to do a cover, Sheila wailed "but I don't know a thing about engineering!" (She is a freshman in the Junior College, having transferred from the Corcoran Art School.) With the characteristic inability of many engineers to produce art work in mind, Sheila's wails were squelched, and the result appears on our cover.

Behind the scenes man on this issue was *Stuart Riggsby*, whose liberal red pencil and well-thumbed dictionary have made their contributions.

One peaceful day, when yours truly, the editor, was munching on some sandwiches, Assistant Circulation Manager *Vince Rider* bounced into the office with his latest contribution to office operations: a complete cross-indexed and cross-referenced alumni file. After this product had been put in its place, Vince busied himself with checking over the advertising and engraving files. All this gusto was received with some surprise and greater admiration by the editors, who after putting their heads together, made Vince office manager. Mr. Rider was last seen peering out from under stacks of work muttering something about politics in high places.

After a forty-five minute chat with *Dean Mason*, and subsequent searching of files, the faculty page was set up. This page was originally intended to be the Dean's page, but was, at his suggestion changed to include the entire faculty of the School of Engineering. When approached on the subject of editorializing on college preparedness, the Dean gleefully consented to write a page. After writing the page, the Dean confided that it had been less than easy, for it is a difficult subject. So to say it better than we of MECHELECIV can, we give you, the reader, Dean Mason on our first faculty page.

Another red-pencil-in-hand addition to the staff this month is *Marilyn Lott*. Marilyn confessed that she actually enjoyed reading copy and galley proofs; she is now on the copy staff.

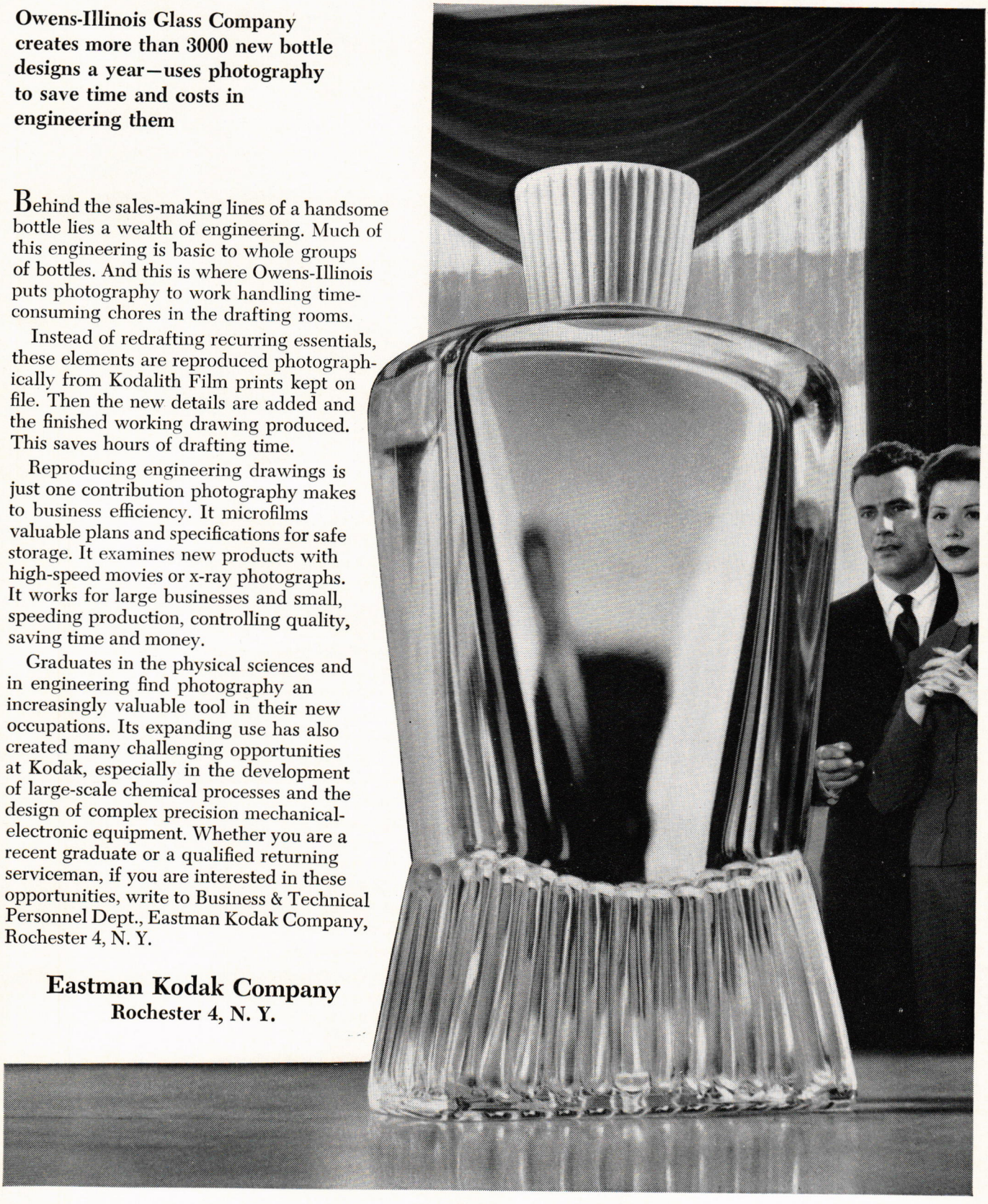
"You know, that's a job!" groaned *Norm Street* as he wiped the ink off his hands and clothes. Norm has, for the past six weeks, been completely revising the engraving filing system, which includes all cuts used in the magazine since MECHELECIV began letterpressing. Norm can now read type and identify pictures backwards and upsidedown with speed that is amazing.

IN OUR NEXT ISSUE: *Stuart Riggsby* out from behind the scene with an article on Nuclear Reactors. Stuart lists one of his hobbies as the study of Nuclear Reactors, so we are all looking forward to his article. *Ray Sullivan* will delve further into engineering in the D. C. area with an article on a local engineering-manufacturing service.

Glass turns salesman

–as photography speeds bottle design

Owens-Illinois Glass Company creates more than 3000 new bottle designs a year—uses photography to save time and costs in engineering them



Behind the sales-making lines of a handsome bottle lies a wealth of engineering. Much of this engineering is basic to whole groups of bottles. And this is where Owens-Illinois puts photography to work handling time-consuming chores in the drafting rooms.

Instead of redrafting recurring essentials, these elements are reproduced photographically from Kodalith Film prints kept on file. Then the new details are added and the finished working drawing produced. This saves hours of drafting time.

Reproducing engineering drawings is just one contribution photography makes to business efficiency. It microfilms valuable plans and specifications for safe storage. It examines new products with high-speed movies or x-ray photographs. It works for large businesses and small, speeding production, controlling quality, saving time and money.

Graduates in the physical sciences and in engineering find photography an increasingly valuable tool in their new occupations. Its expanding use has also created many challenging opportunities at Kodak, especially in the development of large-scale chemical processes and the design of complex precision mechanical-electronic equipment. Whether you are a recent graduate or a qualified returning serviceman, if you are interested in these opportunities, write to Business & Technical Personnel Dept., Eastman Kodak Company, Rochester 4, N. Y.

Eastman Kodak Company
Rochester 4, N. Y.

Put science-engineering backgrounds to work in new General Electric research facilities

Up-to-the-future facilities such as G.E.'s $5 million Metals and Ceramics Laboratory recently dedicated at Schenectady, N. Y., offer unlimited opportunity for qualified applicants with backgrounds of science or engineering.

Historically one of America's research leaders, G.E. continues to expand facilities across the nation for exploring new developments for the home, industry and defense. Research conducted in this Metals and Ceramics Lab, for example, is destined to provide new materials for applications ranging from rockets and atomic power plants to labor-saving appliances. Here, inspecting the surface of a casting, are George Colligan, RPI, and Allan Kiesler, Missouri School of Mines (white shirts).

For careers offering professional growth, investigate G.E.'s Engineering and Science Program. You will be trained in the field of science or engineering most suited to your interests and aptitudes—building on technical backgrounds in physics, chemistry, math or these engineering fields: mechanical, electrical, electronic, metallurgical, nuclear, chemical, aeronautical. 956-3

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